THURSDAY, DECEMBER 15, 1904.

HUMAN ANATOMY.

(1) *A Treatise on Applied Anatomy.* By Edward H. Taylor, M.D., F.R.C.S.I. Pp. xxvii+738; 178 figures and plates. (London: Charles Griffin and Co., Ltd., 1904.) Price 30*s.* net.

(2) *The Human Sternum.* By Andrew Melville Paterson, M.D. Pp. 89; 10 plates. (London: Published for the University Press of Liverpool by Williams and Norgate, 1904.) Price 10*s.* net.

(3) *Der Gang des Menschen.* v. Teil. Die Kinematik des Beinschwingens. By Otto Fischer. Price 5 marks. vi. Teil. Ueber den Einfluss der Schwere und der Muskeln auf die Schwingbewegung des Beins. By Otto Fischer. Price 4 marks. (Leipzig: B. G. Teubner, 1904.)

(1) TO those unfamiliar with the ways of modern medicine the continual appearance of new works on human anatomy must cause some surprise. No subject should be better known, for it has been a matter of almost universal study for centuries. At the best, many will conclude, a new text-book on applied anatomy—the kind of anatomy the surgeon and physician more especially need—can only be a resetting of old facts, and an examination of Dr. Taylor's work will show that, to a large extent, the conclusion is justified. The steady advance of surgery necessitates a continual rearrangement of anatomical perspective; the areas of the body which were under a surgical taboo to the septic surgeons of former days are open to the clean operator of modern times. The brain and spinal cord, the cavities of the ear and nose, the organs within the thorax and abdomen, and the great joint cavities of the limbs, have come, one after the other, within the field of everyday surgical procedure during the last thirty years. In his treatment of these parts of the body Dr. Taylor is quite up to date; his pages reflect accurately the best opinion that is to be found in modern text-books of anatomy and surgery. Still, modern advances will not altogether explain the rapid appearance of new works on anatomy or on any other subject; every generation demands its books on science or literature wet from the press.

The study of this work, containing more than half a million words, furnished with highly finished figures, written with clearness and accuracy, raises the question: is the modern surgeon, as seen in a text-book such as this, a more scientific man than his predecessor of fifty or a hundred years ago? A consideration of a number of subjects in this work, in the treatment of which Dr. Taylor is neither better nor worse than other rising surgeons, will show that, as thinking men, they compare unfavourably with surgeons of past periods. The subjects referred to deal with (1) the appendix vermiformis, the seat of appendicitis; (2) the prostate, which becomes so frequently enlarged in old men; (3) the epididymis, a structure connected with the testicle and very liable to disease; (4) the gall bladder, interesting in connection with the formation of gall-stones; (5) the antrum of the mastoid, an air space connected with the middle ear; (6) the air spaces opening into the cavity of the nose. These six structures are selected because, during the last twenty or thirty years, they have been the subjects of the keenest inquiry, and surgeons have published their observations concerning them in thousand upon thousand of treatises and articles. One would expect that the basis of their treatment would rest on an intimate knowledge of the normal use of these structures. John Hunter, Everard Home, and John Hilton would certainly have sought a complete knowledge of the functions of these parts to serve as a foundation for a rational treatment. Dr. Taylor adopts the orthodox view as regards these structures; he describes their shape, position, and relationships, and the routes by which they may be reached, but not a word is said of their use. Perhaps it is unfair to blame Dr. Taylor for this omission, because it must be confessed that we know much more of the diseases of these structures than of their normal function. Yet in a text-book written for house and operating surgeons surely it is the duty of the author to point out essential gaps in our knowledge rather than to gloss them over by a multitude of unessential details. This criticism is the more pertinent because the author in this case has not taken a narrow view of applied anatomy; he devotes a very large part of his space to a description of operative procedures, pathological processes, embryological defects, and introduces here and there points in physiology.

A great part of this work consists not of applied, but of purely descriptive anatomy. Some years ago Waldeyer, of Berlin, gave an elaborate description of some ten or twelve areas he distinguished within the human pelvis—all of which have been adopted in this book; yet not a word is said as to what manner of use a surgeon can possibly apply them. Again, as regards a small peritoneal recess, which may occur to the left of the terminal part of the duodenum, all the various forms which have been described by hair-splitting surgeons are reproduced in detail. An elaborate description of the condition known as knock-knee is supplied, yet no mention is made of how bones react in their growth to the forces which are brought to bear on them, nor is there any allusion to the forces which normally act on the knee joint.

Surgeon-anatomists have a fondness for the application of certain proper names to surgical procedures and anatomical structures—such as the "pouch of Prussak," the "fossa of Landzert," "Gosselin's fracture," &c. An examination of the index of this work shows that more than one hundred such terms are used, yet, in comparison with many works, the number is indeed very moderate; but one feels they are still rather many. Many terms introduced by surgeons are not words which may be used easily, such as "cholecystotomy" (opening the gall-bladder), "cholecystectomy" (excision of the gall-bladder), "cholecystenterostomy" (making a communication between gall-bladder and intestine), "choledochotomy" (opening the bile duct).

(2) In this monograph, a companion to one on the human sacrum, published in 1893, Prof. Paterson

gives the facts gathered and the conclusions reached during a prolonged research into the development, comparative anatomy, and nature of the human sternum. Leaving aside the convenience of having our scattered knowledge on this subject summarised, and the value of the mass of evidence collected during the examination of hundreds of individuals, the main importance of the work lies in two conclusions which Prof. Paterson draws concerning the nature of the sternum:—(1) that it is fundamentally part of the shoulder girdle; (2) that it is not a segmental structure. Both these inferences are at variance with accepted opinion.

At the present time it is universally taught that the sternum in mammals, birds and reptiles—that is to say, in all vertebrates which use the body wall for the purposes of inspiration—is a composite bone derived from a fusion of the ventral ends of the ribs. The sternum is thus regarded as a structure of costal origin, and having only a secondary connection with the shoulder girdle. In Amphibia, on the other hand, it is recognised that the sternum is developed in continuity with the shoulder girdle, of which it forms an intrinsic part; it is in them a shoulder-girdle sternum. That the shoulder-girdle sternum represents the more primitive type, and that from such a type the costal sternum of the Reptilia was evolved, are assumptions which comparative anatomists will freely grant. At present, however, there is a distinct break in our knowledge of the history of the sternum; no intermediate forms between those two types are believed to occur, and no one, with perhaps the exception of the late Prof. T. J. Parker, has ever formulated a definite theory as to the manner in which the costal sternum of Reptilia could have arisen from the amphibian shoulder-girdle sternum. Prof. Paterson's investigations help us very materially to trace the origin of the costal or, as it may more truly be named, the "respiratory" sternum of the three higher classes of vertebrates from the simple sternum of Amphibia. He shows that the "respiratory" sternum arises developmentally in continuity with the precoracoid element of the shoulder-girdle, and quite independently of the ribs, and that it is therefore merely a modified form of the amphibian shoulder-girdle sternum. Further, the various forms assumed by the "respiratory" sternum in reptiles, birds, and mammals do not, when rightly interpreted, favour Gegenbaur's conception of its evolution by a fusion of the ventral ends of ribs. The sternum of amphibians is the median ventral element of their shoulder girdle, and when Prof. Paterson states that no corresponding element is developed elsewhere in the median ventral line, he overlooks the cartilage developed as a median ventral element in the pelvic girdle which in every sense exactly corresponds to the sternum.

The origin of the "respiratory" sternum is part of a wide problem, viz. in what manner and under what conditions did the body wall become modified to serve as an active inspiratory agent in higher vertebrates, thus replacing the "pharyngeal pump" of amphibians? Whatever may have been the exact manner in which the one form of respiration was evolved from the other, there can be no doubt that the ribs, the intercostal muscles, and the sternum as we know them in higher vertebrates appeared during this phase of evolution. Their appearance is directly due to the introduction of a new type of respiration; the sternum which serves in the higher forms as an element of the respiratory thorax is totally unlike the bone which merely served as part of the shoulder girdle in the more primitive type. With this evidence clearly in view it is difficult to understand how Prof. Paterson concludes that even in mammals the sternum is still—what it was when it first appeared in vertebrates—functionally and fundamentally an adjunct or element of the shoulder girdle. We are surprisingly ignorant of the part played by the sternum in the movements of respiration, even in man, but a cursory examination of its respiratory movements in various groups of birds, and in several orders of mammals, quickly serves to show that its form and size depend chiefly not on the movements of the forelimbs, but on the part it plays in the respiratory movements of the thorax. In our opinion the key to the morphology of the sternum is an accurate investigation of its function.

Prof. Paterson is undoubtedly right in regarding the sternum as primarily a continuous unsegmented median bar. The conception of the sternum as a segmental structure he characterises as "a nebulous transcendental notion." Yet his own evidence shows that the greater part of the mammalian sternum, at the commencement of the cartilaginous and osseous stages of development, is laid down as a truly segmental structure, each segment corresponding exactly to a body segment. Much more "nebulous and transcendental" appears to us his explanation of the occurrence of bony segments or sternabræ as "due to the traction or pressure on the part of the ribs and costal cartilages." In support of this theory Prof. Paterson cites the fact that centres of ossification appear in bones at points of traction and pressure. In the case of the sternum, however, the centres of ossification appear not opposite such points, but exactly between them.

This monograph is well got up; the figures are numerous and highly finished. There is evidently a slight error in Fig. 35, plate v.; the centre of ossification for the fourth segment (if the term may still be used) of the mesosternum is stated to be present in 71 per cent. of cases, whereas in the text (p. 18) the proportion is given as 26 per cent. A curious misprint occurs on p. 33, where the centre just alluded to is said to appear in 59 per cent. of children before birth, and 15 per cent. *after death*—probably meaning after birth.

(3) The brothers Weber were of opinion that in the forward swing of the leg in walking the lower extremity acted as a pendulum, the chief force in action being that of gravity. Duchenne, on the other hand, as the result of a special investigation, came to a totally different conclusion, viz. that the forward swing was almost wholly due to the direct action of muscle. In the fifth and sixth parts of his research into the mechanics of the human gait, Prof. Fischer concludes, after an elaborate analysis of the force expended during

the movement, that Duchenne comes much nearer the truth than the brothers Weber, muscular action playing a much larger part than the force of gravity. Those who have watched the passive movements of a paralysed leg during attempts at progression will have no difficulty in accepting Prof. Fischer's results.

The problem of estimating theoretically the force necessary to produce the forward swing of the lower extremity in walking is an extremely complicated one. Prof. Fischer regards the lower extremity as a pendulum made up of three segments, each of which undergoes certain secondary movements during the swing of the entire extremity. Further, the hip joint, from which the pendulum is suspended, undergoes an irregular forward movement during the swing of the limb. The resistance and elasticity of the muscles and ligaments and the friction at the various joints are factors which can only be approximately estimated.

By means of photographic records Prof. Fischer was able to subdivide the forward swing into forty and forty-one equal phases of time, and by estimating the amount of force in action during each phase he shows that gravity alone can account for only a minor fraction of the force necessarily expended in the movement. Further, the positions assumed by the foot, leg, and thigh during a forward swing show distinctly that various groups of muscles are then in action. He recognises four periods in the forward movement of the limb, each of which is characterised by the action of a distinct group of muscles. In the commencing phase the ilio-psoas bends the thigh on the body, the rectus femoris extends the leg forwards, the tibialis anticus bends the foot upwards; in the second phase the gluteus maximus and hamstring muscles draw the thigh backwards; in the third phase the knee is flexed by the gastrocnemius and short head of the biceps; in the final phase the muscles in front of the leg are again in action, and remain powerfully contracted until the sole of the foot is again planted on the ground.

These results are certainly much more in keeping with clinical and everyday experience than those of the brothers Weber. Many who only occasionally take long walks must have observed that one of the first groups of muscles to give out are those in front of the leg, and that they feel painful only at the end of the forward swing, when the heel reaches the ground—the period at which Prof. Fischer shows these muscles come most powerfully into action. A. KEITH.

EARTHQUAKES.

Earthquakes. By Clarence Edward Dutton, Major, U.S.A. Pp. xxxiii+314; 63 illustrations. (London: John Murray.) Price 6*s.* net.

EPITOMISED and carefully digested accounts of seismological investigations made during the last twenty-five years are few in number. Two have been published in England, a compilation has been "made in Germany," and now we have a volume from the distinguished geologist, Major C. E. Dutton, of the United States. All told, therefore, we have only four books which give the uninitiated some idea of what the new seismology means and what it has accomplished. About the old seismology, volumes, papers, and particularly sermons exist in thousands. But if we except a few, and amongst the few the works of Mallet stand high above the rest, all they give are reiterated narratives of what people saw and heard, now and then enlivened by some wild hypothesis or pious reflection.

Major Dutton's work belongs to another category, and rather than telling us what earthquakes do, his main object has been to tell us what they are, and while doing this he has kept abreast with the work of others which his own inquiries in the domain of seismic and volcanic activities have enabled him to present in a terse and accurate form.

Everything is discussed with a minimum of mathematics from a strictly scientific standpoint, whilst that which is sensational has properly been most carefully put under taboo. A justification for the exclusion of what is of practical importance, which gives not only to the man in the street but to Governments some inkling as to the use of earthquakes, is not so apparent. It is extremely likely that a Prime Minister may not care a twopenny-bit whether the inside of the world on which he lives is red hot or stone cold, while he might be extremely interested to know that seismograms may afford a satisfactory explanation for the interruption of his cablegrams. The importance of earthquake writings to communities who have been alarmed by accounts of disasters in foreign countries is self-evident, while it would at least be consoling to those who were suddenly cut off from the outer world by the failure of their cables to learn whether such failures were the result of an operation of war or of nature. A knowledge of how to construct so that earthquake effects should be minimised means the saving of life and property in countries subject to seismic disturbances. Seismic charts indicate positions where it is dangerous to lay deep-sea cables, whilst they tell the hydrographer where he may expect to find changing depths. In these and in a variety of other directions seismology helps to make communities comfortable, and at the same time acts as incentive to create a popular interest in and to obtain support for a young science. But as Major Dutton defines his standpoint, and as a volume of 300 pages cannot contain everything, our remarks on omissions must only be taken as indications of the hydra-headed nature of seismology.

The first four chapters are chiefly devoted to the cause of an earthquake, which is defined as anything that "calls suddenly into action the elasticity of the earth." Explosions at volcanic foci produce a local trembling, but they are comparatively of rare occurrence and seldom disturb large areas. When a long fault line is produced, and a large territory carrying perhaps mountain ranges drops down along its length, instrumental observations have revealed the fact that the world may be shaken as a whole. Subsequent adjustments along such a line due to intermittent recovery from overstrain and settlements of disjointed materials give rise to numerous after-shocks which are only sensible over areas of small size, and it seems

likely that the greater number of earthquakes felt in the world belong to this latter class. All of them represent a relief of stress, and the discussion on the sources of earth stresses, commencing with the contractional hypothesis and concluding with the results of investigations by Prof. George Darwin, are attractive not only to seismologists but to all who wish to learn something about the inside of the world on which they live.

Some fifty pages are given up to descriptions of seismoscopes and seismographs, attention being particularly directed to those which record unfelt teleseismic movements. We cannot say that the concepts relating to seismic wave motion put forward are generally accepted, but such as they are we may say that they represent modern views. About the amplitudes and periods of earthquake waves seismologists have certain definite information, but about the magnitudes of these elements, particularly for waves which have travelled over long paths, much has yet to be learned. For this latter class of movement it is pointed out that discordant results are found in tables showing the speeds at which they were propagated. The author inclines to the view that the differences which have been noted are due to variability in the delicacy of instruments employed to pick up a wave or wave group. In great measure this may be true, but it seems to us that marked errors may also arise in consequence of inaccuracy in determining the time at which waves were generated at their origin.

Then, again, there are those who incline to a belief, which they sustain with arguments deserving close consideration, that within our earth convection currents exist; it would follow from this that along similar paths, or even along the same path, earthquake speeds should vary.

Notwithstanding these uncertainties, the author holds the opinion that remarkable and unexpected results which fit well within errors of observation have been reached.

Two serious difficulties, for the explanation of which we are asked to wait patiently, relate to the lengthening of wave periods and the total duration of a disturbance as it radiates. We will suggest that the former phenomenon may perhaps be at least partially explained by assuming that in the vicinity of an origin the records refer to forced vibrations, while at a distance the motion represents a periodic natural movement of the crust which varies with its heterogeneity. With regard to the second difficulty, now and then we have evidences that a disturbance recorded at a station far removed from an origin may be reinforced and lengthened by a repetition of the first disturbance which has reached the station by travelling in an opposite direction round the world. Generally, however, the record from a horizontal pendulum near to an origin appears to move as long as, if not longer than, a similar instrument at a distant station, which means that in certain instances the author's difficulty is non-existent. Finally, it must be borne in mind that a single impulse at an origin results in the birth of a series of waves which reach a distant station along different paths and with different speeds, with the result that a blow at an epicentre may at a distance from the same be recorded as a long train of waves.

When Major Dutton suggests to his readers that the Seismological Investigation Committee of the British Association carries on its work in consequence of financial aid received from the British Government, we recognise that he shares a widespread misapprehension.

Much is said relating to the elasticity of rocks, in connection with which an elaborate table, the result of investigations made by Prof. Nagaoka, of Tokio, is reproduced. A second long table is that drawn up by M. Montessus de Ballore relating to the distribution of seismicity.

The illustrations, of which there are sixty-three, are for the most part excellent, but there are one or two photomechanical reproductions of instruments which we imagine will give more delight to their authors at the sight of their own shaky caligraphy than to the ordinary reader.

Taken as a whole, the work is one to be read by all who wish to know what is known respecting the propagation of wave motion in our earth since the invention of the seismograph, and it is destined to receive a hearty welcome.

TECHNICAL MECHANICS.

Die technische Mechanik: elementares Lehrbuch für mittlere maschienentechnische Fachschulen und Hilfsbuch für studierende höherer technischer Lehranstalten. By P. Stephan, &c. Erster Teil: Mechanik Starrer Körper. Pp. viii+344. (Leipzig: Teubner, 1904.) Price 7 marks.

IN the very early part of this excellent work there is a certain lack of system, inasmuch as, although the author very properly treats first of the equilibrium of a *particle*, he assumes the nature of the stress exerted in such rigid bodies as the bars of a framework, the crank and connecting rod of an engine, &c. The nature of such forces is never properly appreciated by the student who is truly a beginner in the subject of dynamics—and, indeed, there is no part of statics in which students of even very considerable experience are so apt to go wrong as that relating to the forces exerted by jointed bars. The author treats from the outset the equilibrium of forces acting in space of three dimensions without having previously disposed of the simpler two dimensional case, a course which meets with the approval of many teachers, although it seems to the reviewer to be the less simple method. Herr Stephan enunciates the parallelogram law for the composition of forces (or vectors generally) at the outset, and assumes it as a result of experiment—which, on the whole, is perhaps the wisest plan for a teacher. Near the end of the book, however, he gives the ordinary Newtonian proof of the proposition.

He gives very early and very clearly the method of determining the resultant of a system of coplanar forces acting on a body (other than a particle) by means of the force and funicular polygons—a subject in which English students are, as a rule, extremely weak. There is a section on the determination of the centres of gravity of all the bodies usually figured in our

English books, followed by a discussion of all the ordinary simple machines—with this difference, that Herr Stephan's figures are much better than those of our text-books. Then follows a discussion of friction, in which, although the author almost invariably solves his problems by introducing the normal force N and the friction μN, he does not omit to point out the utility of the *total resistance* and the angle of friction. He underestimates this utility, however, in solving a simple problem by the N and μN method, and in his final results (p. 118) substituting the angle of friction —a process which simply obscures the merit of the second (and much shorter) method—with the remark that the example shows the advantage which the introduction of the angle of friction "occasionally offers." The truth is that in the hands of a skilful student the geometrical method founded on the employment of the angle of friction and the total resistance is almost always more neat, direct, and simple than the analytical, or N and μN, method. It can be conceded, however, that for engineering students, and technical students generally, this analytical method is the safer, although the longer, and requires less of the *esprit mathématique*. The nature of rolling resistance, which seldom finds mention in our English books, is well explained and illustrated by several applications (pp. 147, &c.). Indeed, the whole of Herr Stephan's treatment of the machines (screw presses, cranes, friction band-brakes, &c.) commonly discussed is excellent, and occupies a very large part of the treatise; it is, in fact, the best and most useful portion of the book.

The only kind of catenary treated of in this volume is the parabola of suspension bridges, to which only two pages and two illustrative examples are devoted. Doubtless the subject will receive more consideration in some subsequent volume.

Herr Stephan is very careful to avoid errors in his figures, and to represent the lines of action of three forces when they keep a body in equilibrium as meeting in a point—a very elementary condition not always observed in our text-books. Once, however, he overlooks this necessity, and represents the lines of action of three forces acting on a bar in a framework (Fig. 164) as forming a triangle of very respectable area.

In the section dealing with the equilibrium of frameworks of jointed bars, he directs attention to the obvious fact, which is not usually mentioned in our books, that even if the bars are loaded throughout their lengths (by their own weights or otherwise) the stresses can be calculated by taking any of the bars as unloaded and weightless, and then superposing the calculated results (p. 197). This simple principle he applies in a special case, and it is one which on many occasions might be employed with great advantage.

The last hundred pages are devoted to kinetics of an elementary kind—including the theory of direct collision of spheres, the compound pendulum, &c.—together with a section on the moments of inertia of various figures and solids. There is no mention made of the very simple and useful rule that a triangular area can be replaced by three equal particles placed at the middle points of its sides—a rule which saves an enormous amount of trouble in the calculation of moments of inertia for all plane areas bounded by right lines. In the absence of this simple rule, a ponderous application of the integral calculus is the only refuge of the student. A somewhat similar "particle rule" saves reams of ponderous calculus work in hydrostatics; but these rules are not widely known.

Herr Stephan very properly makes short work of D'Alembert's principle, deducing it directly from Newton's axioms ii. and iii., so that, although he employs the term "centrifugal force," he is careful, except in one instance, to show that it is a force exerted *by*, and not *on*, a moving particle. The exceptional instance occurs at p. 281, where he is calculating the tension in a driving belt which passes over the surfaces of two revolving cylinders. Here he speaks of a small element of the band as "experiencing" a centrifugal force, which is duly represented, in the usual way, by a centre-flying arrow. His subsequent teaching, however, removes the erroneous notion herein contained.

The book is wonderfully well printed and illustrated, as well as free from mistakes. On p. 15 "Punkte" should clearly be "Kräfte," and on p. 187 the reference should be to Fig. 131 and not to Fig. 135. The theory is illustrated by nearly 200 examples.

To all students who desire to attain a real and physical conception of the subject Herr Stephan's work can be very strongly recommended.

GEORGE M. MINCHIN.

OUR BOOK SHELF.

Machine Drawing. By Alfred P. Hill. Pp. 83. (London: P. S. King and Son, 1904.) Price 2*s.* 6*d.* net.

IN this text-book the author presents a course of instruction which he considers suitable for students attending elementary drawing classes who are unable to spare more than one evening per week, and whose technical training is thus confined to the one subject of machine drawing. Three dozen plates are given, affording a choice of examples to be copied to scale from the dimensions figured, some of which are proportional dimensions covering a range of sizes. Accompanying the plates are descriptive accounts of the construction and uses of the machine parts drawn, with sets of questions founded thereon. At intervals, where space is available, formulæ and physical data are introduced and used in making calculations illustrating machine design. This crude attempt to teach applied mechanics along with elementary machine drawing seems to us a mistake, as, in the absence of a knowledge of mechanical principles, such formulæ as are given become mere rules of thumb, and any attempt to apply them independently cannot fail to be disastrous, as, for instance, in the author's method of estimating the limiting speed of a fly-wheel on p. 42. The time wasted on these premature calculations might very profitably be spent with rule, callipers, and squared paper, in measuring and making careful and complete dimensioned sketches of actual machine parts, and so cultivating the habit of closely and accurately observing constructional details.

Errors abound throughout the book. The author is not a safe guide even in such a small detail as the projection of a hexagonal nut, while his statement on p. 44 that "heat and work are mutually convertible" is a fair index of the scientific value of the work. The volume is somewhat redeemed by a few

good plates prepared from working drawings supplied by makers, but in many cases the figures indicating dimensions are, unfortunately, so small as scarcely to be legible.

An Elementary Class-book of Practical Coal-mining. By T. H. Cockin. Pp. xii+428. (London: Crosby Lockwood and Son, 1904.) Price 4*s.* 6*d.* net.

In general character this useful volume resembles the text-books already available for students of coal-mining. The work is, however, carried to a rather more advanced stage than has hitherto been considered necessary for an elementary class-book, and chapters are given dealing with allied subjects, such as chemistry, mechanics, the steam-engine, and electricity. The order of treatment differs from that usually adopted, the subjects dealt with being:—(1) geology; (2) structure of stratified rocks; (3) coal and coalfields; (4) search for coal; (5) sinking; (6) opening out; (7) miners' tools; (8) explosives; (9) methods of work; (10) working by long wall; (11) methods of working by pillar and stall; (12) special methods of work; (13) timbering; (14) coal cutting by machinery; (15) mechanics; (16) steam; (17) gases; (18) ventilation; (19) instruments; (20) lighting; (21) winding; (22) haulage; (23) pumping; (24) surface arrangements; (25) coke making; (26) accidents; and (27) electricity. This arrangement is not so logical as that adopted by the late Sir C. Le Neve Foster in his elementary work. For example, sinking with rock-drills is described before mining tools, coal-cutting machinery before the elements of mechanics, and electric signals before electric terms are defined. The brief chapter on coke making is hardly necessary, as this subject is usually dealt with in metallurgical treatises. It is doubtful, too, whether the chapters on chemistry, mechanics, steam, and electricity are sufficiently full to give an insight into the allied subjects, for the study of which excellent text-books are available. The illustrations are clear and diagrammatic, and possess the advantage of having been specially drawn for the book.

Bird Notes from the Nile. By Lady William Cecil. Pp. xii+113; illustrated. (London: Archibald Constable and Co., Ltd., 1904.) Price 2*s.* 6*d.* net.

Three claims to high commendation present themselves on the first glance at this elegant little popular work. In the first place, the numerous illustrations are simply exquisite; secondly, technical names are banished from the text; and, thirdly, in the long list of species forming the appendix such names appear to be correctly spelt, and are thoroughly up to date, even to the adoption of the so-called "Scomber scomber" system of alliteration. In her preface Lady William confesses that the notes were written originally solely for her children, who doubtless were desirous of possessing a memento of their parents' Nile trip, but that friends persuaded her to offer them to the public. The adoption of this advice is, in our opinion, fully justified, and while the book has no doubt been found delightful by the young people of the family, it can scarcely fail to be a pleasant companion to the many bird-lovers who make a winter excursion up the Nile. Although no attempt (and very properly) is made at technical descriptions of the various species encountered during the voyage, such notes as are given are in most cases sufficient to render identification an easy matter, to say nothing of the instances when this is rendered self-evident by the illustrations.

R. L.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.]*

Education and National Efficiency in Japan.

The notice of my book "Dai Nippon, the Britain of the East," which appeared in Nature of December 1, directed attention to a nation from which much may be learnt at the present time, and it may interest your readers if I supplement your article by a few notes from my personal experience and observation. In the memorandum issued by Sir Norman Lockyer suggesting the formation of a British Science Guild, it is stated that the people of this country do not manifest that interest in and belief in the power of science which are noticeable among the peoples of the Continent or of America, and that, in spite of the efforts of many years, the scientific spirit essential to all true progress is still too rare, and, indeed, is often sadly lacking in some of those who are responsible for the proper conduct of many of the nation's activities. The British Science Guild has been proposed with the view of attempting to remedy this evil, and to bring home to all classes the necessity of applying scientific treatment to affairs of all kinds.

The objects of such a guild have been attained, to a very remarkable degree, in Japan, not so much by the formation of a special organisation for the purpose, as by the awakening of the national consciousness to the necessity of keeping in mind certain definite aims, and by the earnest cooperation of the various departments of Government, of scientific associations, and of private organisations of many different kinds. There is, indeed, a danger at the present time in this country of too much importance being attached to mere organisation and machinery, and too little to the spirit which pervades them. Mr. Matthew Arnold, in one of his last official reports on elementary schools, pointed out that "our existing popular school was far too little formative and humanising, and that much of it to which administrators point as valuable results is in truth mere machinery." This applies with far greater force to a great deal which has been done in recent years in the way of scientific and technical education. Instruction and knowledge are too often confounded with education, and mere machinery and organisation prevent the development of the scientific spirit. Many of the men who are supposed to have had a complete technical education are very poor specimens of humanity, wanting in individuality and character, devoid of all originality, and with a very narrow view of the world. Some of them may manage to pile up fortunes for themselves, but they will do little to make their country great. Even from a practical point of view, success in any trade or profession does not depend so much on the amount of information which may have been crammed into the learners' heads as is often supposed. It depends incomparably more upon their capacity for useful action than upon their acquirements in knowledge. All experience proves that the spiritual is the parent and first cause of the practical, and especially the economic history of the Middle Ages shows us that an ounce of manly pride and enthusiasm is worth more than a pound of technical skill.

The recent history of Japan has emphasised this fact. While attention has been paid to details, the spirit which has animated the leaders of public opinion and action has been the chief cause of the great developments which have taken place. The complete study of this aspect of Japanese national life would take us into many interesting psychological discussions, but it is sufficient for our present purpose to note that the Japanese mind, unlike the British (which is strongly individualistic), is dominated to a very great extent by collective opinion. At the same time, while Japanese philosophy and their former social order were essentially communistic in their nature, still (contradictory as it may seem) their genius is individualistic, and they impress their personal qualities on their work, although they are willing to sacrifice results to a rigid organisation. The outcome of it all is that the national consciousness is

directed to the attainment of national objects by men whose individual powers have been trained to make effective use of western science, and the results have been simply wonderful.

These results have been most apparent in the operations of war. It was the sound of the cannon on the Yalu River, in the war with China ten years ago, which awoke Europe and America to a knowledge of the fact that a new nation had been born in the Far East, and which at the same time started many of the political problems which have led up to the present war with Russia. That war, whatever its ultimate results may be, has shown that the Japanese have not only been able to take full advantage of the applications of western science, but that they have been animated by the spirit of old Japan, which has made them regardless of personal sacrifices. The Army and Navy have been organised and worked on scientific methods, and with a completeness of arrangements which has won for them the admiration of all impartial critics. Their intense patriotism has caused them to perform deeds of daring which are unequalled in the history of war, while their skill in strategy and in the applications of the latest scientific methods to all they have done has made them almost uniformly successful in their operations. They have demonstrated the importance of the work of the engineer. The railways which have been built in Japan have been fully utilised to convey men and materials, and the ships to transport them oversea. The telegraphs have been used to communicate instructions and to keep the authorities informed regarding movements and requirements. The dockyards and shipbuilding yards have been ready to undertake repairs, and the arsenals and machine shops to turn out war material of all kinds, as well as appliances which aid operations in the field. Light railways have been laid down on the way to battlefields, and wireless telegraphy and telephones to convey instructions to soldiers; in short, all the latest applications of mechanical, electrical, and chemical science have been freely and intelligently employed.

The ships of the Japanese Navy are probably the best illustrations of the Japanese methods of procedure. In naval matters they accepted all the guidance the western world could give them, but at the same time they struck out a line of their own, and the fleet which they have created is unique in the character of its units. British designs have in many respects been improved upon, with the result that they have obtained in their latest ships many features which have won the admiration of the naval world. The inventions and improvements which have been made by Japanese officers, engineers, and scientific men disprove the charge which is very often made, that the Japanese have no originality. Even in the matter of pure science Japanese investigators have shown that they are able to take their places among those who have extended the borders of knowledge. The memoirs and papers published by Japanese students and teachers, both on scientific and literary subjects, will bear very favourable comparison with those of any other country, and while no Japanese Newton, Darwin, or Kelvin has yet arisen, there are men connected with Japanese universities and colleges of whom any learned institution in the world would have no reason to be ashamed.

I must refer to my book for details of the developments which have taken place in engineering and industry. Suffice it to say that roads and rivers have been improved, railways to the extent of between four and five thousand miles have been constructed, a large mercantile marine has been created, docks and harbours have been made, telegraphs and telephones are in use all over the country, excellent postal arrangements are in operation, and there are few departments of mechanical and chemical industry in which there are not many establishments doing very efficient work. The result of it all has been that commerce has been immensely extended, and the financial resources of the country developed in such a manner as to enable Japan to take her place among the powerful nations of the world.

At the root of all these developments has been the very complete system of education which has been established in the country. Elementary schools are to be found in every district, and secondary and technical schools in populous centres, while the universities of Tokyo and Kyoto supply the highest training required for the national life; but for details of these I must again refer to my book. The motive underlying all the efforts is what I wish chiefly to emphasise. Shortly after the Emperor succeeded to the throne, he issued a proclamation which contained the following sentence:—"Knowledge and learning shall be sought after throughout the whole world, *in order that the status of the Empire of Japan may be raised ever higher and higher.*" The recent history of Japan is the most striking illustration of the influence of a wisely directed system of education on national affairs when those who are responsible for it are infused with high national ideals.

At the same time it should be noted that some of the most thoughtful and influential men in Japan doubt whether the official system of education is likely to lead to the best results. They feel, like Matthew Arnold, that too often the machinery and organisation receive more attention than the real education, and, moreover, they dislike the idea of all educational institutions being of the same type. Probably the most influential educationist in Japan was Yukichi Fukuzawa, and he never failed to point out the possible evils which are likely to arise from a too strictly official routine. His own college, the Keio Gijuku, has been a great school for statesmen, lawyers, and public men, and many of the leading men in Japan have been his pupils. Count Okuma, the distinguished statesman, has also established what is essentially a private university, and there are many other schools of different kinds, all of which supplement the Government institutions. Even in the technical and professional establishments, however, attention is not confined to the subjects required for strictly utilitarian purposes or for examinations; the first object is to train *men* who will be able to serve their country, in the fullest sense of that term. Many discussions are now being carried on with regard to the future of education in Japan, and the general tendency of these was indicated a short time ago by a distinguished Japanese author when he said, "No system of education which is not based on sociological conditions can be thoroughly successful, and therefore a study of ethnology, sociology, and of evolution generally is absolutely essential to a thorough understanding of the educational questions awaiting solution." The Japanese are now face to face with many problems which confront all industrial nations, and it is to be hoped that, having organised their education generally, and in some respects given an example to western nations, they will go a step further and show that it is possible to combine industrial development with the welfare of all classes of the community.

The chief lessons which the British Science Guild has to learn from Japan is that if it is to be of any real influence in the life of the Empire, the term *science* must be used in its broad sense, as including all knowledge required for individual and collective life, and that all efforts must be guided by a consciousness of the real aims of national life.

Glasgow, December 6. HENRY DYER.

The Heating Effect of the γ Rays from Radium.

IN a recent communication to the *Physikalische Zeitschrift* (No. 18, September) Paschen has described some experiments which indicate that the γ rays from radium supply a large proportion of the total heat emission. It is known that the heating effect of radium when surrounded by an envelope of sufficient thickness to absorb both the α and β rays is about 100 gram calories per hour per gram. Paschen, however, found that if the radium was surrounded by a sufficient amount of lead to absorb completely the γ rays the heating effect was increased 2·26 times. This large heating effect of the γ rays was so unexpected, and of such great importance in connection with the nature of these rays, that we decided to verify this result by an independent method. In Paschen's experiments, the heating effect was determined in a special Bunsen ice calorimeter, in the central tube of which the radium, surrounded by a lead cylinder about 4 cm. in diameter, was placed. In order to correct for the natural melting of the ice mantle a differential method was employed. In our experiments we decided to use a differential air calorimeter, similar to the one described in our previous work on the heating effect of radium and its emanation (*Phil. Mag.*, February). In each flask of the differential air calorimeter

there was placed a narrow glass tube, closed at the lower end and extending to about the centre of the flask. The radium bromide weighing 23·7 milligrams was enclosed in a small metal capsule supported by a thread, and was inserted alternately in the glass tubes. The flasks, originally at atmospheric pressure, were immersed in a water bath kept in a constant temperature room, and were connected by a xylene tube which served as a manometer. The heating effect was measured by the movement of the xylene column, observed by a telescope with micrometer eye-piece, and the scale was calibrated by a small heating coil of approximately the same dimensions as the radium. Two sets of experiments were carried out, in one of which the ends of the glass tubes were inserted in lead cylinders 3 cm. in diameter and 3 cm. high, and in the other with aluminium cylinders of exactly the same dimensions.

The lead envelope absorbed more than half the γ rays, while the aluminium absorbed only a few per cent. The readings were found to be very steady and consistent, but no appreciable difference in heating effect could be detected in the two experiments. As a check, the heating coil was employed in both experiments to calibrate the readings, the means of which agreed to about 1 per cent.

According to Paschen's results, the heating with the lead cylinders should have been at least 50 per cent. greater than with the aluminium cylinders. In our experiments we could not have failed to detect a difference of 5 per cent. We conclude from this that the γ rays do not supply more than a small percentage of the total heating effect of radium.

E. RUTHERFORD.
H. T. BARNES.

McGill University, December 1

Singularities of Curves.

THE compound singularities of algebraic curves offer a wide field for discussion, but the naming of the simple singularities has not yet been placed on an entirely satisfactory footing. The latter consist of (1) point singularities, which are nodes and cusps; (2) line singularities, which I prefer to call bitangents and inflections. Mr. Basset calls them double and stationary tangents; but if this is done, symmetry requires that the point singularities should be called double points and stationary points, and this is not admissible, because the phrase double points (as now used) includes cusps as well as nodes. If a curve has a double point Mr. Basset calls it *autotomic* (self-cutting); but this term is incorrect when all the double points in the curve are cusps (as in the cardioid), for the curve does not then cut itself. If it is really desirable to have a means of distinguishing curves that have nodes or cusps from those that have none, they may perhaps best be described respectively as curves with or without point singularities.

December 8. T. B. S.

A CHRISTMAS BIRD-BOOK.[1]

THE success which attended his last children's bird-book has induced Mr. Kearton to cater once more for the wants of young people interested in the animal life around them, and the result is the present charming little volume, illustrated, as usual, by reproductions from photographs taken direct from nature by the author and his brother. In the guise of a narrative told by "Cock Robin" to his offspring, the author has contrived to convey in his own inimitable manner a vast store of information concerning bird-life, interspersed with observations relating to other animals. Although, as already said, intended primarily for juvenile readers, the volume contains a certain amount of information which may be new to some of their seniors, including those to whom natural history is not an unknown study. For instance, until we learnt it from Mr. Kearton's pictures, we ourselves were ignorant of the marked and easily recognised difference between the foot-prints of a rabbit and those of a hare, despite the number of times they have come under our notice in the snow.

[1] "The Adventure of Cock Robin and his Mate." By R. Kearton. Pp. xvi+240; illustrated. (London: Cassell and Co., Ltd., 1904.) Price 6*s*.

Generally Mr. Kearton conveys his information in simple language, but he is very prone to speak of a bird picking up food between its two mandibles when it would be "shorter, simpler, and better understood" (to quote from a well known Bar story) if he said beak. Apparently old fables connected with animals die hard, for, according to the author, many young people at the present day believe that a wren is a female robin, and that male robins lose their red breasts in summer.

FIG. 1.—Young Dunlins in their natural surroundings. From Kearton's "Cock Robin." (Cassell and Co.).

These and other old wives' legends Mr. Kearton does his best to replace by accurate and interesting accounts of the mysteries of bird-life.

The best (if there can be a best where all is so interesting) of the five chapters are the two on nesting and the clamour of chicks, both being illustrated by a number of photographs of nests and young birds. Very graphically does the author bring out the remarkable difference in development at the date of hatching between a young sparrow, for instance, and that of a woodcock, and he also shows how much this difference depends on habit, a young skylark showing a somewhat intermediate stage. Very striking are the two photographs here reproduced, the one showing young dunlins skulking amid their native covert, and

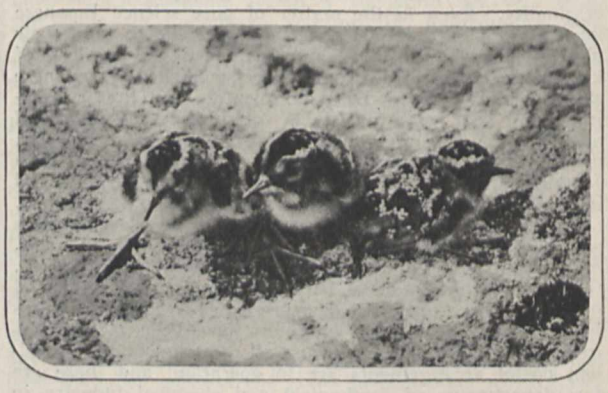

FIG. 2.—The same birds in unnatural surroundings. From Kearton's "Cock Robin." (Cassell and Co.)

the other the same birds removed to an uncongenial environment.

"Nature-teaching" could not be conveyed in a better manner, or in one less free from affectation and faddism, and we trust that the "Kearton annual" will enjoy the extensive patronage that it certainly merits among those on the look-out for suitable Christmas presents for their young friends.

R. L.

THE PRESENT CONDITION OF THE SEA-FISHING INDUSTRY.[1]

"THE methods employed in the capture and transport of fish, the great combinations of capital, the trade organisations, the disputes between the trade and the railway companies, local upheavals, like those of Newlyn and Grimsby, which temporarily paralysed the industry, the efforts of science to unveil the secrets of the sea, and of Parliament first to encourage such investigation and then to act upon its results; these have in turn been briefly dealt with. Lastly, we visited most of the important fishing ports." Such in the author's words is an outline of the plan of this book.

Historically the work is of interest as being the first popular and general account of the sea-fishing industry which has appeared since Holdsworth's "Deep-Sea Fishing," an admirable treatise of similar scope published thirty years ago. A good idea of the rapid progress of the industry in the interval may be gathered from a comparison of the two. Curiously enough, Holdsworth doubted the probability of any extensive adoption of either steam power or the otter trawl in relation to commercial fishing. Contrary to this forecast these very two factors, together with ice and railway facilities, have effected nothing short of a revolution in the industry. It is possible that the next decade or so may also have surprises in store as the result of trade enterprise on the one hand and scientific investigation on the other.

Mr. Aflalo wisely refrains from pronouncing any strong opinions as to future developments.

After a short sketch on "Life in the Sea," in which the chief of the facts known about the life-histories of the edible fishes are mentioned, the author proceeds to describe the various processes involved in the capture and distribution of fish. These subjects receive adequate if not exhaustive treatment, and are made as interesting as possible by Mr. Aflalo's well-known popular style of writing. Then follow two important chapters on legislation and scientific investigation. The final section consists of interesting notes on the different kinds of fishing practised at each important station along the coast, the condition of the harbours (usually defective), railway facilities, local modifications of the share system of wage-payment, and the general prosperity, or otherwise, of the port in question. The contrasts in some cases are very striking, as, for example, between the mushroom-like development of steam-trawling in the hands of syndicates, as at Grimsby, and the moderate but steady prosperity associated with private enterprise at a typical smack-trawling port like Brixham. The former may be safely described as the busiest and least picturesque port in the kingdom, while Brixham, which three-quarters of a century ago supplied the pioneers of the North Sea fishery, and still breeds a notably hardy and resourceful type of man, remains attractive in the old-fashioned way.

In dealing with such controversial matters as legislation and scientific investigation, Mr. Aflalo represents the two sides of a question with some skill, and, absolutely committing himself to neither, has a good word to say for both. Nevertheless, this attempt to steer a sort of middle course among the different opinions leads to no very definite results. The latest Sea-Fisheries Bill he appears to regard as a measure which might do some good, and cannot, in view of its elastic and unbinding character, do much harm; it has, in fact, its good points. International scientific investigation is strongly advocated, "although effectual investigation of the vast bed of the North Sea is out of the question," and "however faulty the Christiania programme may be when analysed on a purely economic basis."

The continued participation of Britain in the international investigations is recommended for the following reasons:—"As a piece of scientific work on an elaborate scale, the North Sea scheme is not unworthy of a century which opened with the discovery of radium and the *n*-rays. As a measure of high politics it is at least equal to the Anglo-French Agreement of which so much more has been heard."

Apart from purely diplomatic considerations, such as the above, the flat-fish problem, which is understood to be receiving special attention at the hands of the international experts, is surely very largely an international one, if only on account of the well-ascertained fact that by far the most important nurseries of the plaice are on the Continental side. One awaits with interest the full details of these researches, especially of certain experiments on the marking of plaice, as a result of which it has been stated (in a short report recently issued by the council of the Marine Biological Association) that the species performs seasonal migrations of considerable extent and definite direction, and further that 20 per cent. of the English marked plaice have been recovered and returned by the fishermen within a year. The latter result indicates an intensity of fishing such as may conceivably affect the supply of this fish. Still more interesting economic possibilities—standing, perhaps, in relation to the last as the antidote to the evil—are suggested by some reports recently circulated in the newspapers. These speak of the phenomenal growth of small plaice liberated on the Dogger Bank, to which they had been transplanted from certain crowded inshore "nurseries." Investigations such as these bear directly on questions of

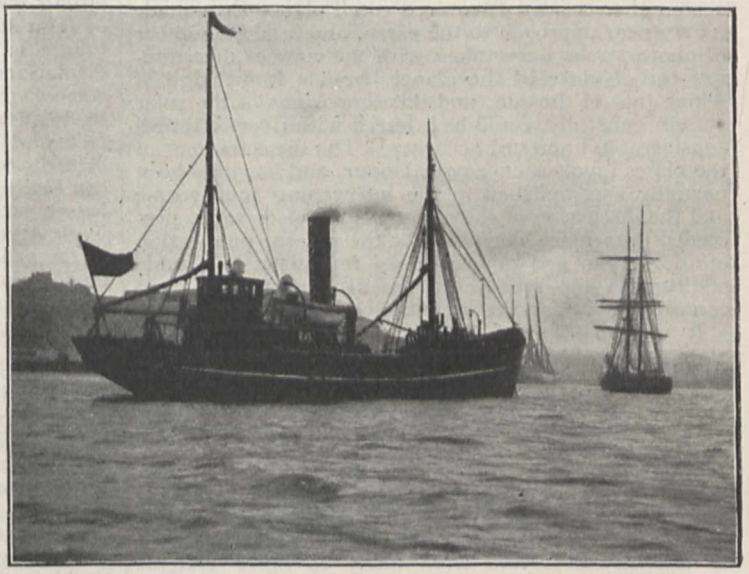

FIG. 1.—The *Huxley*, specially commissioned to carry out fishery investigations. From Aflalo's "Sea-fishing Industry of England and Wales."

[1] "The Sea-fishing Industry of England and Wales. A Popular Account of the Sea Fisheries and Fishing Ports of Those Countries." By F. G. Aflalo, F.R.G.S., F.Z.S. With a sea-fisheries map and numerous photographs by the author and others. Pp. xx + 386. (London: Edward Stanford, 1904.) Price 16*s.* net.

supply, and are evidently inspired by a determination to give something like concrete value for public money.

While awaiting the verdicts of science and the deliberations of legislators, it is useful to have to hand a work such as this, which gives a concise statement and accurate picture of the present condition of the great sea-fishing industry.

The book is abundantly supplied with interesting photographs. There is also a sea-fisheries map, in which, however, is one glaring defect. From this map it would appear that Yarmouth and Lowestoft are given over entirely to the drift-net fishing, and that neither of these places has any connection by rail with the metropolis. This is inconsistent with what is stated in the text, and is opposed to common knowledge.

THE ELEVENTH EROS CIRCULAR.[1]

THE appearance of this volume brings us definitely face to face with a new situation in the derivation of accurate positions of the heavenly bodies from photographs. It will be remembered that in the winter of 1900–1 the recently discovered small planet Eros made a very near approach to the earth, and a large number of photographs were taken with the view of determining the distance of the planet, from a knowledge of which that of the sun, and the dimensions of the solar system generally, could be inferred with (it was hoped) considerably improved accuracy. The measurement of the plates involves enormous labour, and has only been partially accomplished in the intervening four years; and the discussion of the measures has necessarily proceeded even more slowly. But the present publication of more than 400 quarto pages represents a notable addition to the tabular statement of measures, and contains an important contribution to the discussion.

It appears that the plates taken at different observatories are liable to disagreement in a serious manner. Putting aside the planet itself for a moment, when the positions of the stars found from plates taken at the Algiers Observatory are compared with those found from plates taken at Paris, there is a difference varying with the brightness of the individual stars. Such a difference is not altogether new in astronomy; it was pointed out by Sir David Gill a dozen years ago or more that eye observations of stellar positions made by different observers were likely to differ systematically in this manner; but this was attributed to human defects in the observer, and it was hoped that photography would free us from the embarrassment. So it probably will when rightly used; but we have apparently not yet completely realised the necessary precautions. The instruments for taking the photographs at Algiers and at Paris are as precisely similar as the constructor could make them; they were used in the same way; the plates were measured similarly and with careful attention to certain known sources of error, and yet the resulting star places show the following differences in seconds of arc in the mean of 5 groups of 87 stars each :—

Mean magnitude	Difference
	″
8·8	−0·27
9·4	−0·42
10·4	−0·57
11·2	−0·72
11·6	−0·83

There is a range of more than half a second, and we want to measure the hundredth of a second! This is probably an exceptional case; but what may occur once may occur again, and in view of this fact it is not too much to say that a very serious addition has been made to the labour of determining the quantity sought—the solar parallax—by this revelation.

It is disappointing to find no satisfactory suggestion of the cause of error in the paper which gives an account of it. A suggestion is indeed made, viz. that in measuring a plate the presence of an adjacent image (for the exposure is repeated on the same plate so as to show all the images more than once) may disturb the eye of the measurer. All our experience hitherto is against such a possibility. It seems more likely to the writer that the cause may be sought in the object glass of the photographic telescope, and, to be more precise, in an error of centreing of the crown lens relatively to the flint. Such an error is well known to opticians, and is easily detected in a visual telescope by the fringe of colour on one side of a star image when slightly out of focus. But the images formed by a photographic telescope are not examined by the eye in the regular course of work, and such an error might therefore escape detection until revealed by such a comparison of measures as is given above. The stray light on one side of the image would not be strong enough to affect the sensitive film in the case of faint stars, but for a bright star it would spread the image in that direction, and so introduce a spurious displacement of the centre. If this explanation be correct, the error can be both detected and eliminated by turning the object glass through 180° (with most forms of telescope mounting it is only necessary to turn the telescope to the other side of the pier), and this can easily be done. Indeed, it ought to have been done before now, under the admirable maxim for physical work, "reverse everything that can be reversed," but, so far as is known to the writer, the point has hitherto escaped notice.

If on examination this explanation will not fit the facts, some other must be found. A few additional details in the volume before us would have made it possible to test this hypothesis; if, for instance, it had been specified which plates were taken on one side of the pier and which on the other, a comparison of the two sets would have given very definite information. Mr. Hinks has already given cogent reasons (see *Observatory* for September, 1903) for regretting the lack of information as to the identity of the individual plates, and we have now to add this further reason. For the systematic difference described is not confined to Algiers-Paris. If we turn to the paper following that in which M. Trépied gives the figures above quoted and arrange the differences found at the Goodsell Observatory (Carleton College, Minnesota) according to stellar magnitude, we find a well marked effect in R.A. and a smaller one in dec.; and probably other cases, when duly examined, will give similar results, though it does not seem to have occurred to astronomers generally to make a properly searching inquiry. For instance, at the end of the volume M. Lœwy tabulates a series of differences between two lists of star places prepared with great care by himself and by Prof. Tucker, of the Lick Observatory, and he comments with satisfaction on the close accordance of the two lists. But a very slight examination suffices to show that the differences are affected with "magnitude-equation," though in this instance the effect may be due to the visual observations.

In fact, while duly admiring the energy and diligence with which this vast mass of material has been collected and published, a result due in great part to the powers of organisation of M. Lœwy, the director of the Paris Observatory, we may well feel some doubts whether it will turn out to be, as he hopes, a "collection of *homogeneous* material, susceptible of being immediately used without the necessity of undertaking,

[1] Conference astrophotographique internationale de Juillet, 1900. Circulaire No. 11. (Paris: Gauthier Villars, 1904.)

as in the past, long and tedious preliminary investigations" (p. 3). Homogeneity for such a purpose cannot be secured by mere similarity in publication of results; indeed, this very process tends to cover up vital differences of detail, and it is to be feared that, unless these can be unearthed again, the work will suffer in accuracy.

There is an appendix at the end of the volume professing to give a bibliography of the already large literature on the Eros campaign, but containing no reference to the *Monthly Notices* or other English work. Is not this rather a strange oversight?

H. H. TURNER.

NOTES.

BRITISH science has been honoured by the award of the Nobel prize for physics to Lord Rayleigh, and the prize for chemistry to Sir William Ramsay, K.C.B., F.R.S. Prof. Pavloff, of the Military Academy of Medicine at St. Petersburg, has been awarded the prize for physiology. The distribution of the prizes took place at Stockholm on December 10 in the presence of King Oscar and the Royal Family, foreign ministers and members of the Cabinet, and many leading representatives of science, art, and literature. After speeches had been delivered by the vice-president and other representatives of the Nobel committee, and of the Academies of Science, Medicine, and Literature, King Oscar personally presented Lord Rayleigh, Sir William Ramsay, and Prof. Pavloff with their prizes, together with diplomas and gold medals. The sum of money attaching to each prize amounts to about 7825*l*. The distribution of the prizes was followed by a banquet, at which the Crown Prince presided; and among the company were Prince and Princess Charles, Lord and Lady Rayleigh, Sir William and Lady Ramsay, and M. and Mme. Pavloff. Count Mörner proposed the health of Prof. Pavloff, Prof. Petterson that of Sir William Ramsay, and Prof. Hasselberg that of Lord Rayleigh. On Monday Sir William Ramsay delivered a lecture on argon and helium at the Academy of Sciences, and King Oscar gave a dinner party to the prize winners. On Tuesday Lord Rayleigh delivered a lecture at the academy on the density of gases. Both lectures were highly appreciated and greatly applauded. It is announced that Lord Rayleigh proposes to present to Cambridge University the value of the Nobel prize for physics awarded to him.

SIR NORMAN LOCKYER, K.C.B., F.R.S., has been elected a corresponding member of the Imperial Academy of Sciences at St. Petersburg.

THE Lavoisier gold medal, which has been awarded by the French Academy of Sciences to Sir James Dewar, F.R.S., for his researches on the liquefaction of gases, was founded in 1900, to be given, without distinction of nationality, at such times as the French Academy should elect in recognition of eminent services rendered to chemistry by scientific men. The present is the first occasion on which the medal has been awarded to a British man of science.

THE Wislicenus memorial lecture will be delivered before the Chemical Society by Prof. W. H. Perkin, F.R.S., on Wednesday, January 25, at 8.30 p.m.

MR. A. SILVA WHITE, formerly secretary to the Royal Scottish Geographical Society, and editor of the *Scottish Geographical Magazine*, has been appointed assistant secretary of the British Association, and has already taken up the duties of the post.

PROF. BOYCE, of Liverpool University, has proposed to the Liverpool Chamber of Commerce a scheme for the establishment of a commercial museum and bureau of scientific information. The object is to correlate the various scientific forces in the city in order to utilise them for commercial advantage. The scheme has been referred to a committee of the Chamber of Commerce.

ON the invitation of the director, Dr. J. J. Dobbie, F.R.S., and Mrs. Dobbie, a large and representative gathering assembled in the Royal Scottish Museum, Edinburgh, on Monday evening, December 12, to celebrate the jubilee of the museum. The museum embraces three departments—natural history, art and ethnography, and technology, under their respective keepers, Dr. Traquair, F.R.S., Mr. D. J. Vallance, and Dr. Alex. Galt. In the natural history department the collection of fossil fish is one of the most important in the world. Other special features of this department are the hall of British zoology and the zoological type collection, the aim of the latter being to illustrate the bearing of comparative anatomy on the classification of the animal kingdom. The ethnographical collection is one of the most extensive of its kind, and contains many specimens brought home by explorers of the end of the eighteenth and early part of the nineteenth centuries. The technological department contains a large and fine collection of machine and engineering models, most of them made in the museum workshops, together with mining and metallurgical specimens and models. There is also a large collection of economic botany attached to this department. The collections of H.M. Geological Survey of Scotland are housed in the museum, and with these is associated the Heddle-Dudgeon collection of Scottish minerals, which has been described as the finest collection of the minerals of any one country in existence. The museum is supported by a Parliamentary grant, and is under the Scotch Education Department, which was represented at the conversazione by Sir Henry Craik, K.C.B., and Mr. Macdonald, assistant secretary.

A MEETING was held in the geological lecture theatre of the Owens College, Manchester, on December 8, at which it was resolved to establish a Manchester University Geologists' Association. The object of the association is to afford a centre of social reunion for the discussion of geological subjects. Prof. Boyd Dawkins was elected president, Mr. B. Hobson and Mr. Winstanley vice-presidents, Mr. W. J. Hall secretary, and Mr. O. B. Leigh treasurer.

A SHORT time ago Dr. Doyen claimed to have discovered the microbe of cancer, and to have prepared with it a curative serum for the disease. A committee was appointed to investigate Dr. Doyen's claims (see NATURE, October 27, p. 631), and, according to the daily Press, has now reported favourably on them. The *Standard's* correspondent telegraphs, however (December 14), that the committee has not yet arrived at any conclusion.

ON the recent retirement of Sir William Macgregor from the Governorship of Lagos, the Liverpool School of Tropical Medicine decided to mark its appreciation of his valuable services to the cause of health and sanitation by raising a fund, to which Sir Alfred Jones contributed 500*l*. and Mr. John Holt 200*l*. It has been decided to expend this fund on two medical expeditions to the west coast of Africa, one in charge of Prof. Boyce, who, with Dr. A. Evans and Dr. H. H. Clarke, sailed from the Mersey on Wednesday, the other under Colonel Giles. These expeditions will

study the various health problems presented by the districts they visit, the distribution of biting insects, and related matters.

A DEMONSTRATION of the Pollak-Virag high-speed writing telegraph was given on December 9 at the Carlton Hotel in the presence of the Austro-Hungarian Ambassador. The Pollak-Virag high-speed telegraphic system was described upwards of three years ago in a detailed article published in NATURE for May 2, 1901, and readers may be referred to that account for particulars of the instruments used. Very high speeds—reaching 100,000 words an hour—were reported as having been attained in America in 1901 by this system, using several perforating machines to prepare the message being sent; but it now appears that these estimates were too high. The postal authorities in Hungary in recent experiments carried out between Budapest and Pozsony, a distance of some 218 kilometres, with two copper telephone wires of 3 mm. diameter, secured the transmission of 45,000 words an hour. In another series of experiments, conducted between Berlin and Königsberg, a maximum transmission of 40,000 words an hour was attained over a distance of 710 kilometres with wires 4·5 mm. in diameter. It is stated that our Post Office department is about to carry out some trials of the Pollak-Virag system.

THE performances of an intelligent horse—"Clever Hans"—at Berlin two or three months ago attracted much attention. In a letter which appeared in NATURE of October 20 (vol. lxx. p. 602) the Rev. J. Meehan pointed out that the performances of the horse were much the same as those of the horse "Mahomet" shown at the Royal Aquarium twelve or thirteen years ago, and depended entirely upon the animal's observation of movements of the trainer or the tones of his voice. Much the same opinion has been reached by a commission of psychological experts, headed by Prof. Stumpf, of Berlin University, that has subjected "Clever Hans" to a scientific examination. The conclusion arrived at is that the horse is not capable of independent thought. According to the Berlin correspondent of the *Daily Chronicle*, Prof. Stumpf found that this horse is gifted with remarkable powers of observation, which four years of patient and skilful treatment have developed. When asked a question "Hans" knows he has to beat with his hoof in reply, but he does not know when to cease beating until he detects some movement on the part of the person questioning him. The commission expresses the opinion that, so far as Herr von Osten, the owner, is concerned, these movements are given involuntarily, and are sometimes of so imperceptible a nature as to be undetected, save by highly trained human observers. There has been no trickery, says Prof. Stumpf, but, on the other hand, there have been no reasoning powers on the horse's part. The whole secret is in von Osten's skill, patience, and judicious reward, and, on "Hans's" part, in keen powers of observation.

VISITORS to the Zoological Gardens in the Regent's Park will miss the old Indian rhinoceros "Jim," which had been a denizen of the menagerie since July 25, 1864, on which date it was presented to the society by the late Mr. A. Grote. It died on December 7, after having been out of health for many months. Such a long sojourn in captivity in this country is probably unparalleled for an animal of this kind. As a statement has appeared in the Press that the skin might perhaps be mounted in the British (Natural History) Museum, it may be well to state that His Highness the Maharaja of Kuch-Behar recently presented the skin of a wild specimen of the great Indian rhinoceros to the museum, which has been set up, and is exhibited. The "Zoo" specimen will therefore not find a home in the national collection.

THE December number of the *Century Magazine* contains a most interesting account, by Mr. G. H. Grosvenor, of the new method of purifying water—both in small quantities and when stored in large reservoirs—by means of blue vitriol (copper-sulphate). It has long been known that copper is fatal to bacteria, but the fear has hitherto been that the amount required to effect the destruction of such organisms would likewise be injurious to man. Dr. G. T. Moore has, however, announced in an American official publication that he can employ copper in such a diluted form as to be quite harmless to the higher forms of animal, and yet sufficiently potent to destroy the germs of cholera and typhoid, as well as mosquito larvæ, in a few hours. The method of introducing the copper-salt into the water is fully explained in the article. It may be added that the treatment is stated to be equally efficacious and safe for sterilising milk. As an illustration of the effects of copper in destroying bacteria, it is mentioned that such organisms are never found on copper coins, although abundant on those of silver, and it is mentioned that artisans in copper-works are immune to bacterial diseases. Whether we have been wise in abolishing the old-fashioned copper tea-kettle is one of the questions raised by the new operations.

THE discovery of the existence of an anterior rudimentary pair of gills in the Continental fresh-water crayfish *Astacus fluviatilis*, which is not present in the common *A. pallipes* of the Thames, was described by Prof. Lankester in NATURE of January 21 (vol. lxix. p. 270), and is recorded in the November issue of the *Quarterly Journal of Microscopical Science* by Miss M. Moseley, who appears to have inherited her father's love for biological studies. The other four papers in the same number are of a very technical nature, the longest and perhaps the most important being a detailed account by Mr. J. W. Jenkinson of the maturation and fertilisation of the egg of the axolotl (*Amblystoma tigrinum*). More general interest attaches, however, to the article by Prof. L. Rogers on the development of flagellated organisms or trypanosomes from the protozoic parasites found in the spleen in cases of cachexial fevers and certain other diseases. Of the two remaining articles, the one by Dr. J. Rennie discusses the so-called epithelial islets in the pancreas of bony fishes, while the second, by Dr. H. G. Fowler, is devoted to the description of the anatomy of a radiolarian of the genus Gazeletta.

IN an article entitled "A Flamingo City," which appears in the December number of the *Century Magazine*, Mr. F. M. Chapman, of the American Museum of Natural History, gives a graphic and well illustrated account of one of the great breeding-places of the American flamingo in the Bahamas. Although previous observers, both in those islands and in Europe, have published descriptions of flamingo colonies, and have refuted the old error that the birds sat straddle-wise on their nests, the author claims to be the first to have seen nestling flamingoes in their native haunts, and likewise to have brought the camera to bear on one of the breeding-places of these birds. Flamingoes, as Mr. Chapman remarks, are more brightly coloured than any other large bird, and their gregarious habits and the open nature of their resorts are admirably suited to bring their gorgeous hues into prominence. The visit to the nesting-grounds was made at the latter end of May, when both eggs and young birds were to be found in the nests.

At first the birds—estimated at 2000 in number—rose in a flock, and fears were entertained that they would permanently forsake their nests, but after a time—despite the erection of a "blind" for the camera—they returned in a body. The sight of such an army of large birds, both in flight and when marching, is described as magnificent and imposing, if not, indeed, appalling. The young remain in the nest for about three days, and for the first three weeks after leaving it feed like ordinary birds. By that time, however, the beak has attained its characteristic flexure, and the young birds then search for their food with the lower mandible upwards. Molluscs of the genus Cerithium form almost the sole food of the Barbados species. It is sincerely to be hoped that a movement to prevent these "rookeries" from being raided by the plumage-hunter will be attended with success.

In vol. iv. of the *Bulletin* of the Imperial Botanic Garden at St. Petersburg, Mr. J. Palibin describes the plankton which he collected in Barents Sea, and also gives a historical *résumé* of other collections made in the Arctic Ocean. In a series of letters Mr. Boris Fedtschenko communicates the botanical observations made during a journey through the Sir Daria region of Turkestan.

In a pamphlet entitled "Notes on the Commercial Timbers of New South Wales," Mr. J. H. Maiden describes the principal woods, their characters, and uses. The information is primarily suited to practical men who supply or use timber in the colony. The majority of the timbers are hard woods, and different species of Eucalyptus give ironbarks, stringy barks, varieties of box, mahogany, and gum. The timbers recommended in lieu of pine are white beech, *Gmelina Leichhardtii*, a genus of the order Verbenaceæ, and red cedar, *Cedrela australis*, and rosewood, *Dysoxylon Lessertianum*, both included in the Meliaceæ.

The establishment of "biologic forms" of species of Erysiphaceæ and Uredineæ is based upon the restricted powers of infection of the spores upon allied species of the host plant. But the immunity of a species of the host plant is not absolute, because, as pointed out by Mr. E. S. Salmon in No. 3 of vol. ii. of the *Annales Mycologici*, another host plant may act as a bridging species. Thus the form of *Erysiphe graminis* which grows on *Bromus racemosus* will infect *Bromus hordeaceus*, but will not infect *Bromus commutatus*, although the spores found on *Bromus hordeaceus* will infect *Bromus commutatus*. If spores from *Bromus racemosus* are sown on *Bromus hordeaceus*, then the spores produced on *Bromus hordeaceus* as a result of that sowing are found to be capable of infecting *Bromus commutatus*.

The daily weather report issued by the Meteorological Office on Tuesday, December 6, showed that on the morning of that day the winds and sea in the Channel were still very heavy, and, further, that a rapid fall of the barometer at Scilly pointed to the approach of a fresh disturbance. This storm developed very rapidly, and by 2h. p.m. a deep disturbance lay over Dorsetshire, and another to the north of the Helder. These disturbances were accompanied by very heavy rainfall, amounting in twenty-four hours to 2·25 inches at Cuxhaven, 1·25 inch at St. Aubins (Jersey), and 0·94 inch in London, while severe thunderstorms occurred generally in Devon and Cornwall. Much damage to property is reported from various districts, and in parts of Dorsetshire a veritable tornado occurred; rain and hail fell in torrents, accompanied by heavy thunder and lightning. At Beaminster roofs and trees suffered severely; the path of the storm was well defined, and, as is usually the case in these local whirlwinds, was limited to a very small area. The region of heavy rainfall over the country generally was sharply defined on its northern side; at Nottingham and Spurn Head no rain was reported to the Meteorological Office on the morning of December 7.

A volume of monthly wind charts for the South Atlantic Ocean, prepared by the marine branch of the Meteorological Office, has just been published by the Hydrographic Department of the Admiralty. The region covered extends from the equator southward to the 65th parallel, and from the 20th meridian of east longitude to the 90th of west longitude, so that a portion of the Pacific is included. Nearly a million sets of observations, extending over a period of forty-five years, have been used. The winds have been discussed in areas of 5° of latitude by 5° of longitude, and the results are exhibited by means of roses showing the relative frequency and strength at the sixteen even points of the compass. The distribution of mean atmospheric pressure is shown by means of isobaric lines, and the mean air temperature by isotherms, while along the African and American coasts are numerous notes bearing upon the characteristic climatic features of the various months. A striking feature on every chart is the area of high barometric pressure covering the whole of the area between Africa and the east coast of America, its central space being usually more on the western side of the ocean, as is the case with the anticyclone of the North Atlantic. The wind circulation of the South Atlantic is associated with its dominating high pressure system. On the eastern and northern portions of the ocean the south-east trade is very constant, is never interrupted by storms, nor attains the force of a gale. On the western side the winds are more variable, but gales are very rarely experienced northward of the 35th parallel. Except near the land fogs seldom occur northward of the 30th parallel, and the south-western part of the ocean is the only region where ice is ordinarily met with. Statistics of the rainfall at a number of places within the area of the charts show that the annual amount ranges from 0·31 inch at Walfisch Bay and 1·54 inches at Serena (Coquimbo) to 93·41 inches at Pernambuco and 100·63 inches at Valdivia. It may be recalled that at the Cambridge meeting of the British Association Commander Hepworth read a paper on the results of the discussion of the observations for these charts.

In No. 22 of the *Physikalische Zeitschrift* Messrs. Elster and Geitel reply to Mr. J. R. Ashworth's recent letter to Nature (vol. lxx., p. 454) suggesting that the human breath may be considered as a source of the ionisation of the atmosphere. Their measurements of the conductivity of air charged with ordinary human breath show that such air is not more conducting than ordinary air. On the other hand, the breath of a person who has been working continually with radium preparations has decided ionising power, and the nature of the ionisation shows that it is due to the emanation of radium.

Nearly all the physicists who have been approached hitherto by the *Revue Scientifique* in the course of its inquiries as to the existence of the *n*-rays have unequivocally stated their inability to observe the effects which these rays are alleged to produce. It is therefore particularly interesting to note in the *Revue* for November 26 that M. D'Arsonval has been able to reproduce these effects in many instances, and to show that they are not due merely to thermal causes. M. Mascart is stated jointly to have observed with him the same phenomena. M. Poincaré,

although himself unable to verify the existence of the radiations, adversely criticises Prof. Wood's objections. M. Weiss, from his failure to observe the rays, simply concludes that he was physically unfitted for such observations.

PART xii. of the *Transactions* of the Royal Dublin Society consists of an investigation by Mr. Richard J. Moss of the state in which helium exists in pitchblende. The total quantity of helium in a sample of pitchblende was 0·107 c.c. per gram, and of this 1·17 per cent. was liberated by simply grinding the mineral in a vacuum. The quantity of carbon dioxide separated by completely decomposing the mineral was 4·686 c.c. per gram, of which only 0·0085 per cent. was obtainable by grinding. As a similar proportion of the total occluded carbon dioxide can be separated from calcite, in which the gas is undoubtedly present in minute cavities, by simply pulverising the crystals, it is probable that the whole of the carbon dioxide of pitchblende, and possibly the helium also, are present similarly occluded. It is evident that the proportion of the gases liberated by roughly grinding must necessarily be only a small proportion of the total volume.

THE Christmas number of *Photography*, published by Messrs. Iliffe and Sons, Ltd. (1*s*. net), is restricted to many kinds of work with the camera which can be accomplished indoors during the winter months. It might be said further to deal with the lighter side of photography as well, as will be judged by reading the second portion of this number. Part i., by Mr. C. J. Harrison, deals with the working up of negatives and prints for the removal of mechanical and other defects from negatives. The methods and dodges employed are, as the author states, the outcome of his own experience, but nevertheless they are interesting reading, and may prove serviceable to many photographers. The illustrations accompanying the text and chosen to represent various stages of these methods are also well worth examination. In part ii. Mr. W. L. F. Wastell discourses on bye-paths of photography. Here the reader is made acquainted with methods for producing what may be termed "freak" photographs. Thus we have illustrated examples of the so-called "spirit" photograph, distortions due to the object being too near to the camera, two images of the same person in one picture, combination portraits, silhouettes, and many others of a similar character. The supplement to this number consists of designs, covering sixteen pages, of photographic mounts to serve as Christmas cards.

THE articles in the October number of the Johns Hopkins Hospital *Bulletin* (xv., No. 163) are mainly of medical interest. Dr. Packard, however, writes an interesting account of some famous quacks, including Valentine Greatrakes, who claimed the healing touch for the King's evil in the seventeenth century, no other than Robert Boyle testifying to his powers; Joshua ("Spot") Ward, who discovered a cheap way of making oil of vitriol; and John St. John Long, who devised a famous liniment which possessed not only curative powers, but also revealed hidden disease, and from his practice is said to have derived 13,000*l*. a year.

MR. W. B. CLIVE has published a revised and enlarged edition of "First Stage Building Construction," by Mr. Brysson Cunningham.

MESSRS. DAWBARN AND WARD, LTD., have published in their "Home Worker's" series a booklet by Mr. R. H. S. Williams with the title "How to Build a Bicycle," and one on "How to Build a Petrol Motor," by Mr. J. F. Gill.

THE separate parts (parts i.–vi.) of "A School Geometry," by Messrs. H. S. Hall and F. H. Stevens, which have been reviewed in these columns from time to time, have been published together in one volume by Messrs. Macmillan and Co., Ltd., at 4*s*. 6*d*.

A FOURTH edition of Prof. Olof Hammarsten's "Text-book of Physiological Chemistry" has been published by Messrs. John Wiley and Sons, New York (London: Messrs. Chapman and Hall, Ltd.). This issue is an authorised translation by Prof. John A. Mandel from the author's enlarged and revised fifth German edition.

THE 1904 issue of the "Year-book of the Scientific and Learned Societies of Great Britain and Ireland" has now been published by Messrs. Charles Griffin and Co., Ltd. This is the twenty-first annual issue of a useful list of organisations for the advancement of science, literature, and art, and of work done year by year. Comprehensive as the compilation is, it is not quite complete, for there appears to be no reference either to the Sociological Society or to the Geographical Association.

Erratum.—In the inscription of Fig. 5 (p. 135) of the article on "Invar" in last week's NATURE, "a 2 km. wire" should read "a 24 m. wire."

OUR ASTRONOMICAL COLUMN.

RELATIONS BETWEEN SOLAR AND TERRESTRIAL PHENOMENA.—In a paper communicated to the Royal Society of New South Wales, Mr. H. I. Jensen, of Sydney University, discusses the more recent data concerning sun-spot frequencies and the occurrence of volcanic outbursts, earthquakes and climatic variations, with the view of illustrating further the dependence of the terrestrial upon the solar phenomena.

In a previous paper communicated to the same society in June, 1902, he arrived at the conclusion that the maxima of volcanic and seismic activity coincided, in point of time, with the sun-spot minima, but the discussion of the later data has led him to a confirmation of the views expressed by Sir Norman Lockyer, viz. that the maximum activity of the terrestrial takes place at both the minima *and the maxima* of the solar phenomena. His observations show, however, that the action at sun-spot maxima is less marked than, and of a different character to, that which takes place at the minima.

The differential action of lunar attraction is also discussed, and although the author concludes that this cause is only one of secondary importance, he shows that volcanic outbursts and earthquakes seem to occur most frequently at those times when the moon is in perigee.

In discussing the connection existing between solar and meteorological variations, Mr. Jensen refers to the work performed in this direction by Sir Norman and Dr. Lockyer, and in general agrees with their results, although he inclines to the belief that the epochs of sun-spot *maxima* are generally the epochs of excessive rainfall. Further, he strongly insists upon the necessity of attaching more importance to geographical position when considering the prevailing meteorological conditions of any place (*Proc.* Roy. Soc. New South Wales, vol. xxxviii.).

SUN-SPOT SPECTRA.—In No. 4, vol. xx., of the *Astrophysical Journal* Father Cortie brings together the results of all the sun-spot spectra observations made at the Stonyhurst College Observatory during the period 1883–1901.

Using a Browning automatic spectroscope containing twelve 60° prisms, the widened lines in the region B–D of the solar spectrum were picked out, and the intensity of their relative widening recorded on an arbitrary numerical scale. The present catalogue results from 5486 individual observations of 349 lines, and the results generally confirm the observations made at South Kensington as recorded by Sir Norman Lockyer in a paper ("On the Relation between the Spectra of Sun-spots and Stars") recently communicated to the Royal Society, viz. that vanadium and titanium are the elements chiefly affected in sun-spot spectra.

Father Cortie states that the widening of some oxygen lines in sun-spot spectra, particularly in the α band, seems to be a real phenomenon.

ECLIPSE OBSERVATIONS.—Vol. iii. of the *Annalen* of the Royal University Observatory of Strassburg, edited by Dr. E. Becker, the director, contains the results of the heliometer observations of the total solar eclipse of May 28, 1900, and of the lunar eclipses which took place on January 28, 1888, May 11, 1902 (partial eclipse), and April 11, 1903, respectively.

In the first part Prof. Kobold gives the results of a number of observations made in order to determine the reduction elements of the heliometer, and then applies them to the observational results obtained during the solar eclipse of 1900. Finally, he gives the corrections to the previously determined positions. In part ii. the same observer discusses the observations of the 1888 and 1892 eclipses of the moon, and gives the values obtained for the radius of the earth's shadow, &c., finally comparing them with the calculated values.

In the third part Herr C. W. Wirtz discusses the observations of the lunar eclipse of April 11, 1903, including the corrections to the moon's place, the figure and size of the earth's shadow, and the variations of the diameter of the crater Linné during the eclipse. The curve on which are plotted the values of the last named quantity shows a considerable increase in the diameter during the approach of the earth's shadow to the crater, the maximum value evidently occurring during the actual eclipse of Linné.

THE APPEARANCE OF SPARK LINES IN ARC SPECTRA.—An interesting discussion of the conditions which lead to the appearance of "spark" lines in arc spectra is published in No. 4, vol. xx., of the *Astrophysical Journal* by Dr. Henry Crew, of the North-western University, Ill. Dr. Crew made a number of experiments in which the Mg line at λ 4481 appeared in the arc spectrum, and examined the arc, simultaneously, with a Rowland grating spectrograph and a Duddell high-frequency oscillograph.

The various conditions under which the arc was produced were as follow:—(1 and 2) current with negligible and with large amount of inductance respectively; (3) arc broken by air blast; (4) arc in atmosphere of coal gas.

The reproductions of the oscillograph curves show the current conditions during each experiment, and from a discussion of the results Dr. Crew arrives at the following conclusions:—(1) A rapidly changing, high E.M.F. is a probable *conditio sine qua non* for the appearance of spark lines in arc spectra. (2) The effect of hydrogen and other atmospheres in introducing spark lines is explained by the fact that these atmospheres produce a more rapid break, and this, in turn, introduces an extra E.M.F., which in some way, as yet unknown, is responsible for the radiation of the spark line. A possible explanation of the stellar conditions which produce spark lines in the spectra of stars is also discussed.

THE ROYAL ASTRONOMICAL SOCIETY OF CANADA.—Founded as the Astronomical and Physical Society of Toronto, the name of this society was changed in 1900 to that of the Toronto Astronomical Society. In 1903 it was decided to change its name to the Astronomical Society of Canada, and in response to a petition the privilege of prefixing the word "Royal" to its name was granted, so that the full title of the society is now the above heading. We hope that this now national society will be a stimulus to the promotion and diffusion of astronomical science, and that its influence will be greatly extended. We have before us the volume containing the selected papers and proceedings for the years 1902 and 1903, edited by A. Harvey; the varied topics there dealt with bid fair for the future of the society. Among some of the papers may be mentioned the address of the president, R. F. Stupart, director of the Magnetic and Meteorological Observatory of Toronto, in which is an account of the history and work of the institution. W. H. S. Monck gives a catalogue of aërolites, arranged in order of the months in which they fell. There is a brief account of the present astronomical equipment of Canada as a whole, and a discussion on papers dealing with solar phenomena and terrestrial effects. The volume concludes with an account of women's work in astronomy, by Miss E. A. Dent.

THE FIRST TRUE MAPS.

IN the history of cartography, in the development of maps and map-making, there is perhaps nothing quite comparable to the first appearance of the "portolani" or "handy charts" at the close of the thirteenth and the beginning of the fourteenth century. For the portolani, the first true sea-charts, are also the first true maps of any kind—the earliest designs in which any part of the earth-surface is laid down from actual observation of close and continuous character.

By the term "portolani" we intend, of course, to refer to that great series of coast-plans of which the earliest known examples belong to the first decade of the fourteenth century (A.D. 1300–1310); which are traceable to a very few, perhaps to two or three (now lost), originals; which may be extended to cover at least 500 designs (reaching down to the end of the sixteenth century); and were primarily intended to serve as practical guides to mariners and merchants in the seaports of the Mediterranean and Black Sea.

These plans of practical navigators—of men whose livelihood largely depended on their knowledge of nature and their close observation of natural features—are a remarkable contrast, in their almost modern accuracy, to the results of the older literary or theological geography as we have them in the Hereford or Ebstorf maps (both of the very same period as the oldest existing portolans, *c.* A.D. 1300). They have never yet received adequate attention from English geographers (as from Nordenskjöld the Swede, Fischer the German, or Uzielli the Italian), and the problem of their sudden appearance in such comparative perfection is surely deserving of more study, and capable of fuller explanation, than it has yet received. Certain assumptions may perhaps be made without danger. The portolano type was not the invention of one man, of one year, of one decade. It did not spring from any school or any example of mediæval student-map. It was the final result of centuries' experience—the outcome of the notes, plans, and oral tradition of generations of pilots and captains. Skipper-charts of certain important and much-frequented sections of the coast trade-routes were probably combined, by slow degrees, into a coast-chart of the Mediterranean basin as a whole. It may be that the sketches of small portions of shore-line which we have in fifteenth century manuscripts of Leonardo Dati's poem "La Sfera" are really copies, but slightly modified, of such old skipper-charts—reaching back, perhaps, to the eleventh century, and forming the very earliest indications of that new scientific geography in which the compass played so great a part. If this surmise is correct, the opening of the mediæval Renaissance, in the generations immediately preceding the Crusades, was accompanied by the oldest embryonic forms of modern cartography.

Once more, it may be that the sea-chart which is mentioned in connection with the Seventh Crusade (of A.D. 1270), and which St. Louis apparently employed to aid his attack on Tunis, was a portolan, or a sectional chart of the North African coast of portolan type. It may be that the *charta* noticed in Raymond Lulli's "Arbor Scientiæ" (about A.D. 1300) as necessary for sailors—along with the compass, needle, and "star of the sea"—was a work of the same kind. It may be that Andrea Bianco's planisphere of 1436 is a re-edition of a "handy-map" of the thirteenth century. But the oldest certain examples of the type we are concerned with, which have been discovered up to the present, are the *Carte pisane* and the first design of Giovanni de Carignano, both belonging to the opening years of the fourteenth century, while the oldest dated portolan is the first of Pietro Vesconte (or Visconti), executed in 1311.

And when, with these and the next few examples, we get at last our full coast-chart of the Mediterranean basin, what is its character?

It is a map without graduation, embracing only the coast lines and the towns and natural features in the immediate neighbourhood of the coast. But though it is restricted, it has extraordinary merits in its own field. Its delineation of the shores of the *Mare Internum*, from the Straits of Gibraltar to the extreme east of the Black Sea, is markedly superior to anything of earlier date—even to the Madaba

mosaic of the sixth century or to Matthew Paris's thirteenth century "England." The chief errors which Ptolemy had imparted to the shape of the Mediterranean are corrected. The main features of the great inland sea are presented with a correctness and a minute detail which, at the most casual glance, immediately distinguish portolan work from any preceding variety of cartography. No attempt is made to fill up the interior of the lands—continental or insular—of which the coasts are portrayed; such attempts are made later, it is true, but they are obvious and confessed additions to the primitive, normal, or typical portolan. But, along the shores in question, all points important for navigation are drawn with great care; small islands, bays, cliffs, and headlands—of no great general importance, but vital to the coaster—are often depicted in disproportionate size; all the ports especially suitable for calling, watering, and revictualling are indicated with the especial honour of *red* colouring; even shallows are frequently marked, denoted by a sign still used at the present day; the very large number of shore-names testifies to the minute knowledge underlying the work. Thus along the north coast of the Mediterranean we have (by A.D. 1320) about 620 names; on the coasts of the Black Sea and Sea of Marmora about 260; on the coasts of Asia Minor and Syria about 160; on the north coast of Africa about 240; in all some 1280, without counting island names—which are very numerous—or the names which fringe the western coast of Europe to the mouth of the Elbe, and the western coast of Africa to Cape Nun, or Non, at the extreme south-west of Morocco. In respect to these shores—let us say from Hamburg almost to the Wady Draa, and from Gibraltar to Azov, Poti, Batum, Alexandretta, Jaffa, and the Nile—the portolani soon become fixed in the pattern they permanently retained, a pattern which gradually triumphs over every other—even the revived Ptolemaic, to which scholars clung so desperately and so unhappily. We may therefore regard the great mass of these works as mere copies of a few normal or typical designs which were completed (at least in all their essential parts) before the outbreak of the Hundred Years' War, and a good twenty years before the battle of Crecy. How closely the original type was followed may be guessed from the fact that the portolan *colours*—used according to certain definite rules—are unaltered for long periods of years, and through scores of examples. Thus red or reddish-brown is always kept for the Red Sea, and long after the Turkish conquest of Rhodes that island regularly appears in white with a black cross.

Instead of lines of latitude and longitude (or substitutes for such lines, as we find in the "Palestine" of Marino Sanuto, *c.* A.D. 1310), a net of loxodromes is employed on (or has, at any rate, been added to) the portolani even of the earliest time. These loxodromes are straight lines in the direction of the various winds, proceeding from a number of crossing-points regularly distributed over the map. But in this loxodrome net-work, in sharp contrast to all other features of the portolan map-type, there is almost infinite variation; one seldom comes across two designs of exactly similar character in this respect.

A distance-scale, with the same unit of length, occurs on all the portolani; this unit (which has been called the *portolan mile*) is estimated with much care by Nordenskjöld at 5830 metres; while of all known mediæval measures, that which corresponded most nearly with the "portolan mile" seems to have been the Catalan *legua*. A Catalan league therefore, it is suggested, may have furnished the basis of the portolan measure, and the portolan type of map may have originated (in part at least) among Catalan mariners.

Baron Nordenskjöld, indeed, does not hesitate to ascribe to the portolani an entirely Catalan parentage. But, admitting that one germ of the first true maps may have existed at Barcelona or some other centre of Catalonian trade and seamanship, I cannot but think that another germ still more active and important was to be found in Italy, and above all in the north-west—in Genoa and Pisa. For, remembering the indications in Dati's "Sfera," we may agree with Theobald Fischer that map sketches of portolan type, and with the practical object of helping navigation, were almost certainly drawn *in Italy, and by Italians*, before 1300. Remembering, also, that of the existing portolani all the earliest examples are unquestionably Italian—and that, of some 500 known, 413 were executed by the countrymen of Carignano and Vesconte—we shall not be ready to deprive Italy of the first place in the creation of the oldest scientific maps. Even if that creation was, as seems probable, an "Homeric" feat—the piecing together (with additions and improvements) of a great number of small sectional coast-surveys—yet this earlier stage, only recorded in Italian manuscripts, seems no less due to the seamen of the peninsula.

Can we throw any other light upon the origin of the portolani?

In 1881 Fiorini suggested that West-European mariners, such as those of Italy, learnt from the Byzantines the art of making and using maps founded on careful draughtsmanship and close study of distance (*i.e.* portolani of a kind) as early as the eleventh century. This idea has been accepted by Theobald Fischer, and has been treated with great respect by other scholars. Yet it is surrounded by difficulties. For no Greek portolan has yet been found, nor is Greek influence anywhere to be detected in the language, legend-allusions, contours, or other details of the early portolani. Fragments of Latin, fragments of Italian and Catalan dialects, fragments of a *lingua franca* composed of various Romance tongues—these are the media through which the early portolan draughtsmen convey information. But of Greek they make no use, and of Byzantine geography, history, harbours, or coast routes they show no *special* knowledge. We may give weight to the fact that the Byzantine navy was one of the chief Christian weapons in the ninth, tenth, and early eleventh centuries; that Constantinople was then the greatest trade centre in Christendom; and that the seamen of the Greek islands were very prominent in Mediterranean navigation in the age of the Byzantine revival (*c.* 860–1060 A.D.). But all this is far from proving a Byzantine right to the "invention" of the portolan coast-chart,[1] even in the primitive form of sectional pilot-maps of limited areas.

It only remains to say that all genuine progress in geographical delineation followed the lines of the portolani; that the accurate methods employed by them for coast-work were gradually applied to the interior of countries; that in spite of the contempt shown for them by most of the learned in the so-called Renaissance period, they were at last known by their fruits and vindicated by the success of their type.

Ancient classical or pre-Christian maps were not without certain merits, though we can only judge of them by the two remaining examples, the Peutinger table, originally a road-map of Augustus's Empire, and the designs illustrating the "Geography" of Claudius Ptolemy of Alexandria—both surviving only in manuscripts of the central mediæval period. After the modern age of oceanic discovery had passed through its earliest and most difficult stages, the Renaissance editions of Ptolemy (from 1474) played a very important part in delaying geographical progress and retarding the history of civilisation. But in the time of the early portolani (say from 1300 to 1400) neither the work of the Alexandrian astronomer nor the road-maps of the Roman Empire were adequately known in western Europe. The sixteenth and seventeenth centuries were not so innocent.

Designs of the portolan type do not seem to have existed even in the best ages of classical geography and exploring activity; the old *peripli* were sailing directions, not drawn, but written; and the only Arabic scheme of the sort which has yet been found is certainly copied from a Christian—and Italian—original.

It is in the portolani, and especially in such a work as the Laurentian design of 1351, with its revelations of the Azores and the Madeira group, and its still more startling suggestion of the true shape of Africa, that we may find, perhaps, the chief geographical teachers of Henry the Navigator and his Portuguese. Never better than in these long-neglected charts does the history of civilisation illustrate man's change from empirical to scientific, from traditional book-learning to the investigation of nature. The portolani long

[1] To Nordenskjöld's wild theory, "Facsimile Atlas," p. 48, that Marinus of Tyre is the real original portolan draughtsman, and that the Marinus maps which Masudi saw before A.D. 956 were really portolani, we need not pay attention.

suffered, in general appreciation, from the fact that—in their essential features—they never attempted to gratify popular taste; that they did not, with rare exceptions, illustrate[1] the works of fashionable writers, whether classical philosophers or mediæval prelates; that they had no connection with the legends and dreams of chivalry and romance; that they were not the work of schools or courts; and that they owed nothing to Ptolemy or Strabo. But we know their worth better now.

They first record for us the new discoveries among the Atlantic islands and along the African mainland; they guide and accompany the faltering steps of our race in the outward, oceanic, movement of European life; in them true cartography, the map-making of the civilised world, begins.

C. RAYMOND BEAZLEY.

GEOLOGICAL NOTES.

STATISTICS of mineral production in India in the ten years 1894 to 1903 have been issued by the Government of India (Department of Revenue and Agriculture, 1904). In the report for 1903 satisfactory progress in the mining industry is recorded. There has been a remarkable development in the production of petroleum and manganese ore, and a continuation of the progress previously recorded for coal and gold.

From the Geological Survey of India we have received part ii. of the newly re-issued *Records*. Mr. T. H. Holland, director, contributes a short appreciative memoir of the late General C. A. McMahon, and among other articles there is a well illustrated report by Mr. J. Malcolm Maclaren on the auriferous occurrences of Chota Nagpur, in Bengal. The conclusion is that there is little scope for the legitimate investment of capital in the recovery of gold, whether from the quartz veins or from the superficial deposits, but that the greater portion of the gold must be left to the native washer, "forming for him a reserve that, though it will never raise him to affluence, will always lift him beyond the grasp of famine." Two minerals, thenardite and cancrinite, are recorded for the first time from India. We have also received a report on the geology of Spiti, by Mr. H. H. Hayden (*Mem.* Geol. Surv. India, vol. xxxvi., part i.). Hitherto no systematic survey had been made of the region, and the results of this work, which was carried out by Mr. Hayden with the assistance of the late Dr. von Krafft, are depicted on a map to the scale of one inch to four miles, and further illustrated by some striking pictorial views and sections. The formations represented are Cambrian, Silurian, Carboniferous and Permian, Trias, Jurassic, and Cretaceous, with also intrusive rocks. The oldest sedimentary rocks belong to the Middle Haimanta division of Mr. Griesbach; they are unfossiliferous, and are overlain presumably by the Upper Haimantas, in which Lingulella and Olenus have been found. Lower and Upper Silurian rocks are recognised, and from these and the later formations many fossils are recorded.

The ammonite fauna of the Spiti shales forms the subject of a monograph by Dr. Victor Uhlig (*Mem.* Geol. Survey, India, ser. xv., vol. iv.). Only the first portion of this work has at present been issued, and in it the author deals with the genera and species of Ammonoidea. With regard to the classification, the author remarks that as no universally satisfactory agreement has yet been reached, he gives the descriptions of the various forms in unclassified sequence, while indicating their approximate position. In the course of his work he has studied as far as possible all the old as well as new material, and he has found it necessary to re-figure and describe many of the species previously published.

In mineralogical notes contributed by Mr. A. K. Coomaraswamy (*Spolia Zeylanica*, August), reference is made to the occurrence in Ceylon of thorium-bearing minerals, of corundum-sillimanite rocks, kyanite, serendibite, &c. The same author, in dealing with the geology of Ceylon (*Geol. Mag.*, August), proposes the name Balangoda group for a series of granitic and pegmatitic rocks intrusive in the Charnockite series. The group includes granites with zircon, allanite, magnetite, &c.

The summary of progress of the Geological Survey for the year 1903 contains the usual particulars of the field work which has been carried on in Cornwall, Derbyshire and Nottinghamshire, Carmarthenshire and Pembrokeshire, in various parts of Ross-shire and the western highlands, in the Edinburgh coal-field, and in the neighbourhood of Cork in Ireland. Special attention is directed to the discovery in Ross-shire of a rock essentially composed of magnetite and cassiterite—the occurrence of tin-ore being new; but it is stated that at present there is no reason to believe that the tin-bearing rock occurs in any large masses. In an appendix Dr. J. S. Flett contributes first notes on the petrography of western Cornwall, dealing with some of the garnetiferous greenstones, the granites and greisen veins, and the phenomena of contact alteration; Mr. H. B. Woodward writes on the Geological Survey in reference to Agriculture, with report on the soils and subsoils of the Rothamsted estate; and Mr. H. A. Allen continues the important catalogue of types and figured specimens of fossils in the Museum of Practical Geology, with a record of Oolitic Gasteropoda and Scaphopoda.

The general report and statistics on mines and quarries for 1903, part iii. (output), has been issued by the Home Office. The total value of the minerals raised during the year showed a decrease of 5¼ million pounds as compared with 1902—a decrease arising from the fall in price of coal. The total output of coal was the highest hitherto recorded. The outputs of ores of iron, copper, and lead show increase, while those of manganese, tin, and uranium ores show decrease.

In the *Proceedings* of the Bristol Naturalists' Society (n.s., vol. x., part iii.) Prof. Lloyd Morgan and Prof. S. H. Reynolds give particulars of the field relations of the Carboniferous volcanic rocks of Somerset. There is also an interesting article by Mr. W. H. Wickes on the Rhætic bone-beds, the author pointing out that there is no regular and persistent bed, but thin layers of varying extent occur on different horizons, due to the former presence and destruction of shoals of carnivorous fishes and saurians, while the occurrence of small pebbles in the bone-beds is attributed to the fact that large sea fish often have stones in their stomachs. Mr. H. B. Woodward contributes a memoir on the late Robert Etheridge, dealing more especially with his work in the Bristol area.

In the *Proceedings* of the Cotteswold Naturalists' Field Club (vol. xv., part i.) Messrs. J. W. Gray and G. W. S. Brewer direct attention to the evidence of a Celtic settlement on Cleeve Hill, prior to the Roman occupation of that part of the country; among the domestic animals were the horse, ox, sheep, pig, dog, and fowl. Mr. L. Richardson contributes an article on the Rhætic beds of Worcestershire.

A study of sands and sediments has been commenced by Mr. T. Mellard Reade and Mr. Philip Holland (*Proc.* Liverpool Geol. Soc., 1904). So far as their investigations have proceeded, they are led to believe that purely mechanical micro-sediments may constitute a much larger proportion of the rocks than has been hitherto suspected. Moreover, their experiments show the persistent retention of detrital carbonate of lime in extremely fine subsidence-matter, and suggest that deep-sea limestones may sometimes be formed as detrital accumulations.

The twenty-eighth annual report of the Department of Geology and Natural Resources, Indiana, under the direction of Mr. W. S. Blatchley, State geologist, is accompanied by an excellent geological map of the State on the scale of an inch to four miles, with explanatory descriptions by Dr. T. C. Hopkins and Dr. A. F. Foerste. The formations represented are Ordovician, Silurian, Devonian, Lower Carboniferous, and Coal-measures. The petroleum producing areas are specially marked, that industry having become one of the greatest in the State. Special reports are contributed on this and on the lime industry, and there is also an article on the stratigraphy and palæontology of the Niagara formation by Mr. E. M. Kindle, with twenty-five plates of fossils.

[1] Some of the atlases founded on portolani, such as the *Carte Catalane* of 1375, really illustrate the travels of the thirteenth and fourteenth centuries, *e.g.* Marco Polo's. But this is strictly in the way of explanation of a great eographic text.

A comprehensive memoir on the geology and ore-deposits of the Bisbee Quadrangle, Arizona, by Mr. F. L. Ransome, appears as one of the "professional papers" of the United States Geological Survey (1904). This district became famous for its production of copper-ore in 1880, and was connected with the railway system as recently as 1902. Hence Mr. Ransome has found himself obliged to invent names—and pleasing ones of Spanish origin—for several topographic features. His plates show how the geological structure of the country can be read on many of the hill-sides with the clearness of a diagram; in several respects they remind one of the bare dry landscapes in the Mesozoic areas of the Basses Alpes. The fossiliferous beds include Middle Cambrian, Devonian (apparently conformable on these), Lower and Upper Carboniferous (both marine), and Cretaceous, resting unconformably on the preceding beds. The affinities of the strata are with those of Texas. The paper concludes with a discussion of the origin of the copper-ores, in which stress is laid on their concentration from cupriferous iron-pyrites, deposited in metamorphosed lime-stone.

In the *Proceedings* of the Royal Society of Victoria (vol. xvii., n.s., part i.) Messrs. F. Chapman and G. B. Pritchard commence an article on the fossil fish-remains from the Tertiaries of Australia. They deal with the description, range in time, and distribution of the sharks, and they observe that Asteracanthus, hitherto known only from Secondary strata, extended beyond question into the Tertiary seas round southern Australia. In other articles the Silurian Ostracoda and Phyllocarida, and the Tertiary Polyzoa and Mollusca of Victoria receive attention. Prof. J. W. Gregory contributes a paper on the antiquity of man in Victoria, and concludes (contrary to his previously expressed opinion) that, however ancient the Australian aborigines may be, there is no evidence of the long occupation of Victoria by man.

We have received the annual report of the Geological Survey of Canada for the year 1900, issued in 1903; it is accompanied by geological maps, dated 1904, of parts of British Columbia (Atlin Gold-fields), Labrador, Saskatchewan, and Quebec.

A revision of the Palæozoic Palæechinoidea, with a synopsis of all known species, has been contributed by Mary J. Klem (*Trans.* Acad. Science, St. Louis, vol. xiv., No. 1). She remarks that the prevailing characters which may be taken as a basis for classification are:—(1) number of columns in the ambulacra; (2) position and number of the ambulacral pores; (3) ornamentation of the plates; (4) imbrication of the plates; (5) apical system; (6) general shape of the body; and (7) geological position.

An interesting article on the occurrence and distribution of copper in the United States, by Mr. W. H. Weed, appears in the *Mining Magazine* (New York, September). Nearly 700 million pounds of metallic copper were produced in the States during 1903, and in the previous year nearly 300 million pounds were obtained from an area a mile long and half a mile wide at Butte, in Montana, where the Anaconda Mine produces more copper than any other mine in the world. The ores occur in well defined veins in quartz-monzonite, associated with white granite or aplite, which forms dykes and small masses. Dykes of quartz-porphyry also occur, and seem to have some genetic association with the ore-bodies. Several mines are 2200 feet deep.

The Geological Survey of Queensland has commenced the issue of *Records*. In No. 1 Mr. B. Dunstan, the acting Government geologist, contributes notes on the occurrence of gold nuggets near Mount Morgan, on phosphate-bearing rocks, asbestos, oriental rubies, &c. Mr. R. Etheridge records the occurrence of Halysites in the Chillagoe lime-stones. We have received also *Publications* Nos. 191 and 192, on the tin, copper, and silver mining in the Stanthorpe district, by Lionel C. Ball, and on the Herberton tin field, by Mr. W. E. Cameron.

Some Upper Devonian fish-remains, obtained by Dr. Whitman Cross from Colorado, are described by Mr. C. R. Eastman (*Amer. Journ. Sci.*, October). The remains belong to the genera Bothriolepis and Holoptychius. In the same journal a number of fossil turtles belonging to the Marsh collection in Yale University Museum are described and figured by Mr. O. P. Hay. Many of the specimens are from the Laramie deposits of Wyoming.

SCIENTIFIC RESEARCH IN THE PHILIPPINE ISLANDS.

THE occupation of the Philippine Islands by the United States has been quickly followed by the establishment of laboratories, and already a large amount of scientific work has been done, and several valuable reports have been issued.

The report[1] under review deals with the year ending September, 1903. The permanent buildings of the Government laboratory at Manila were completed last April, and comprise a serum laboratory for the preparation of therapeutic sera and vaccine lymph with attached paddocks and animal houses, a chemical laboratory, a biological department for the prosecution of pathological, entomological, and botanical research, a marine biological station, a bureau of weights and measures, and a library.

About one-third of the volume is occupied with a report on trypanosomiasis by Dr. Musgrave and Mr. Clegg, with special reference to the existence of surra among the horses in the Philippines. At the same time a very complete review of our present knowledge of trypanosomiasis is given, the various species are described, and the symptomatology and prophylaxis are discussed. The report, which is a very valuable one, is copiously illustrated with excellent photographs, temperature charts, &c. Several other papers of pathological interest are included in the volume; also an account of rinderpest inoculation.

Another valuable report is on the gutta-percha industry and the various gutta-percha-producing trees, and is illustrated with a number of photographs of species of Palaquium and Payena, methods of collection of the gutta-percha, maps of geographical distribution, &c.

The final third of the volume contains the report of Mr. Charles Banks, the Government entomologist, and gives an account of the insect pests attacking the cacao. This, like the rest of the papers, is copiously illustrated with excellent photographs.

The volume reflects the greatest credit on the staff of the laboratory, but the complete omission of a table of contents and an index should be remedied in future issues.

R. T. HEWLETT.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—A chair of music has been established by an endowment of 10,000*l.* given for that purpose by Mr. Richard Peyton, of Birmingham. The chair has been accepted by Sir Edward Elgar; but the intention of the university authorities is by no means to interfere in any way with his work as composer, and he will be left free to develop the chair gradually and on such lines as he, in consultation with other members of the Senate, may think fit.

Dr. Arthur Robinson, of King's College, London, has been elected to the chair of anatomy, vacated by the appointment of Dr. Windle to the presidency of Queen's College, Cork. The new professor will assume office in January.

A new chair of electrical engineering has been established as a supplement to the lectureship in the same subject held by Dr. D. K. Morris. The first occupant of the chair will be Mr. Gisbert Kapp, now lecturer at Charlottenburg. He is not expected, however, to return to this country until the autumn of next year, and his appointment will not take effect until October, 1905. Meanwhile, and subsequently, Dr. Morris and his staff will continue their work as before. The new and large buildings for the department will be ready by that time. A competent assistant will have to be elected to assist Prof. Kapp in the drawing office for dynamo and central station design.

Prof. Burstall will continue to occupy his chair, the title of which will be changed to "Mechanical Engineering," and he will have control over a great engineering block and the power station.

It is not improbable that a special chair of civil engineering in the narrower sense will be established.

[1] Report of the Superintendent of Government Laboratories in the Philippine Islands for the Year ended September 1, 1903.

EDINBURGH.—Sir Donald Currie has subscribed the sum of 25,000*l.* toward the fund which is being raised by the university to enable a site to be purchased on which laboratories and other educational buildings could be erected, and for making further financial provision for an extension of the teaching staff and for the promotion of research in the university. To the principal, Sir William Turner, Sir Donald Currie stated that he wished the revenue from this money to be applied by the university court to the remuneration of a staff of lecturers, such as the authorities of the university might find it advisable from time to time to appoint. An option was also given to the university court to apply 5000*l.* of the amount towards the purchase of a site for the new laboratories, should it be necessary to use a portion of his gift for that purpose. In addition to this gift, subscriptions amounting to 15,000*l.* have been promised by other friends of the university.

ACCORDING to a report mentioned in *Science*, it is proposed to move the Western University of Pennsylvania from the suburbs of Allegheny to Pittsburg proper, near the new Carnegie Technical School. About fifty acres of ground, sufficient for twenty large university buildings, are being secured at a cost of about 400,000*l.*, and the work of construction will be begun before long. Fifty citizens of Pittsburg have agreed to give each from 8000*l.* to 20,000*l.* for the school. From the same source we learn that the general assembly of the State of Vermont has appropriated 12,000*l.* for the use of the agricultural department of the university. The money is to be expended in the erection and equipment of a building to be known as Morrill Agricultural Hall, in memory of the father of the agricultural colleges of the country, the late Senator Justin S. Morrill.

IT may be remembered that the authorities of University College, Sheffield, were informed by the committee of the Privy Council that, subject to a substantial realisation of the hopes entertained in connection with the movement for the establishment of a Sheffield University, their Lordships would be prepared in due course to recommend to His Majesty the grant of a charter. We learn from the calendar of the University College for 1904–5 that of the sum of 170,000*l.*, which efforts are being made to raise, 54,134*l.* has been promised since 1903. In addition, 52,908*l.* was promised in 1902 to the new buildings fund, so that some 107,042*l.* has been raised for higher education in Sheffield within a short period. It is to be hoped that little difficulty will be experienced in securing the amount which must be provided still before the University of Sheffield can be incorporated.

TWO technical State scholarships have been just placed at the disposal of the local government of the Punjab, says the *Pioneer Mail*. These scholarships will enable natives of India to pursue a course of study in Great Britain or other western countries with the object of qualifying them to assist in promoting the improvement of existing native industries and the development of new industries wherever this may be possible. In the case of the Punjab the industries allowed to be taken up are tanning, metal-work, and pottery, and the local government has decided to confine its efforts to the first two, at any rate for the present. The value of each scholarship has been fixed at 150*l.* a year, and it will be tenable for two years, but it will be open to the Government of India to increase the value of any scholarship, and to extend the period during which it will be tenable. Commissioners and superintendents of divisions have been asked to make the scheme publicly known, and to enlist in its behalf the interest of the commercial classes.

THE annual prize distribution and students' conversazione at the Northampton Institute, E.C., was held last week, when the prizes and certificates were distributed by Lord Reay. The principal's report showed that the work of the institute has in several important departments overtaken the accommodation, and that there is urgent necessity for extension. A special note was made of the recent recognition of the work of the institute by the Board of Education; and the necessity for a "British Institute of Technical Optics" was pointed out. Lord Reay, in his address, dwelt upon the desirability of reviving, so far as modern conditions would allow, the old system of apprenticeship, and pointed out how the polytechnics and technical institutes could be made useful in connection therewith. The vote of thanks to Lord Reay was moved by Mr. Alexander Siemens. After the distribution the various laboratories and workshops were thrown open, and a series of lecturettes, exhibits, and demonstrations was given. The most interesting demonstration was perhaps that of a new submersible boat in the swimming bath. These boats, invented by Mr. Middleton, of Brighton, are propelled, directed, controlled, and governed by fins actuated by prime movers, in such a fashion that they can move any way in tri-dimensional space in the fluid in which they are immersed. By altering the inclination of the plane of the fins, these can be made to propel the boat forwards or backwards, to sink it below the surface, to raise it again, and, in fact, to direct it along any course, whether inclined to the horizontal or otherwise.

THE proceedings of the Institute of Chemistry of Great Britain and Ireland for 1904, which have now been published, show that the council of the institute has had under consideration the recommendations of the Consultative Committee to the Board of Education for a scheme of examinations for school certificates. It will be remembered that it is proposed that these school certificates should take the place of the many professional preliminary examinations now held; that a central board should be constituted for England, consisting of representatives of the Board of Education and of the different examining bodies, to control the standard of the examinations for school certificates; and that the proposed examinations should be under the control of independent external examiners, although conducted by internal and external examiners jointly. The council of the Institute of Chemistry has informed the Board of Education (*a*) that the council considers it desirable to substitute some such system as is proposed in lieu of the various professional preliminary examinations now held; (*b*) that if such a system be established, the council will be prepared to accept the proposed senior certificate examination, passed in the subjects required by the regulations of the institute; and (*c*) that the council will be pleased to be represented on the proposed central board. A scheme for school certificates submitted by the University of Birmingham has also met with the approval of the council of the institute, and it has also been decided to accept the matriculation examination held jointly by the Victoria University, the University of Liverpool, and the University of Leeds, as an approved preliminary examination, provided the certificate include the subjects required by the regulations of the institute.

A DEPUTATION from the Association of Chambers of Commerce of the United Kingdom waited upon Lord Londonderry, President of the Board of Education, on Monday to urge that increased Government aid should be given to higher technical and higher commercial education. The views of the deputation were expressed in the following resolution, which was passed at the meeting of the association on September 28, and was now laid before Lord Londonderry:—"That, in order to retain our industrial position and to introduce into this country such further industries as may be profitably developed, this association is of opinion that it is absolutely necessary to establish or acquire public secondary schools of the highest standard, where efficient means of such education do not exist, with fees low enough to make them accessible to all grades, and to provide sufficient inducements by bursaries, exhibitions, scholarships, or otherwise to make the efficient boys stay long enough in these schools in order to thoroughly train and adequately prepare a very much larger number than is at present available for taking full advantage of the provisions made for higher technical and higher commercial education, the facilities for which ought also to be largely extended and the standard considerably raised." In introducing the deputation, Sir W. H. Holland, M.P., said the chambers of commerce might be fairly taken to represent the organised commercial opinion of the country, and they were convinced that the Board of Education would encourage them to take a keen interest in secondary and technical education. Mr. Ivan Levinstein said the want of secondary education was the cause of our present most deplorable position. What we wanted, in the first instance, was a far larger number of

high-class public secondary schools. We must be prepared to face a great financial sacrifice, for some years at any rate, if we were to put secondary education in this country on anything like the level it had reached in America, Switzerland, and Germany. After other speakers had put forward similar claims for consideration of the subject, Lord Londonderry, in reply, said that he felt the weight of the arguments put forward, but the opinions of his colleagues of the Board of Education and himself on this vitally important matter were expressed in such detail and so definitely in the reply forwarded by Mr. Morant to the chamber on September 26 (see NATURE, October 13, p. 595) that on the present occasion he proposed to devote attention rather to the question of commercial education than to that of technical education. The whole matter was one to which the Board were fully alive, and he was very glad to learn from the representations which they had made that day that there was on the part of the chambers of commerce a keen appreciation of the value of that special advanced instruction in the several sections of mercantile practice which the Board had felt it their duty to encourage in the evening schools serving the more important commercial communities.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 11.—"On Certain Properties of the Alloys of Silver and Cadmium." By Dr. T. K. **Rose.**

Attention was directed to these alloys on account of the advantages of using them as the material for trial plates for testing the fineness of silver coin and plate. An examination of the curves of equilibrium between the liquid and solid states of the alloys proved the existence of several compounds of silver and cadmium, some of which have already been recognised in other ways. Horizontal branches of the curve mark the solidification of the compounds Ag_3Cd_2, AgCd, and $AgCd_3$, and the solidification of Ag_2Cd_3 corresponds to a cusp on the curve of initial freezing points.

There is a strong tendency for mixtures of the compounds to form solid solutions. This is strikingly shown in the case of alloys containing more than 80 per cent. of silver. At temperatures in the short range of a few degrees between the initial and final freezing points of these alloys, two bodies exist side by side, but at a lower temperature they coalesce to form a single solid solution provided that sufficient time is allowed for complete mixing by diffusion. For example, in the standard alloy, which contains 7·5 per cent. of cadmium, solidification begins at about 945°, and is completed at about 913°. If the alloy is maintained at some temperature between these points a network of a silver-poor body is gradually formed surrounding crystals of a silver-rich body. If the alloy is subjected for some hours to a temperature a little below 913°, large crystals with regular boundaries are formed occupying the whole area of the field. These alloys are remarkably ductile.

The alloy corresponding to the formula Ag_2Cd is fine-grained and apparently homogeneous. If heated for some time to a temperature of 750°, somewhat below its point of solidification, the cadmium from the surface is volatilised, leaving a layer of pure silver. On removing this during the operation of polishing a black layer is met with, coloured by oxide of cadmium, and underneath this the original alloy is found to exist. The layers are not everywhere of the same thickness, so that in the course of polishing alternate rings of black and white are produced, resembling the well known Japanese decorative metal-work called Mokumé, which is used in jewellery.

The alloy containing about 50 per cent. of silver consists of crystals of a silver-rich body, often pinkish in colour, set in a white matrix composed of $AgCd_3$. The 40 per cent. alloy is a hard, brittle substance, the compound Ag_2Cd_3. As the percentage of silver decreases, a matrix, consisting mainly of $AgCd_3$, makes its appearance surrounding the crystals of Ag_2Cd_3, and specimens containing less than 25 per cent. of silver consist of crystals of $AgCd_3$ set in a matrix of cadmium.

Several similarities to the silver-zinc series of alloys have been noted.

November 24.—"The Refractive Indices of the Elements." By Clive **Cuthbertson.**

In a letter addressed to NATURE in October, 1902, attention was directed to the fact that the refractivities of the five inert gases of the atmosphere, He, Ne, A, Kr, and X, as determined by Ramsay and Travers, were, within narrow limits of accuracy, in the proportion of 1, 2, 8, 12 and 20; or, more simply, of ½, ½, 2, 3, and 5.

In a second letter it was shown that the refractivities of the halogens, Cl, Br, and I, stand also in the relation of 2, 3, and 5 to the same degree of accuracy; but it was pointed out that the figures for P, As, and S, as measured by M. Le Roux in 1861, did not show any similar relation; and it was observed that a re-determination of them would be interesting.

With a Jamin's refractometer, adapted for use with high temperatures, results have now been obtained for Hg, P, and S, which differ widely from those of M. Le Roux. The index of mercury, calculated for a molecule containing two atoms, is placed at 1·001857, a number which agrees closely with the value given by the refractive equivalent of Gladstone. The index of P_2 is found to be 1·001197, and that of S_2 is 1·001101.

In all three cases it is estimated that the margin of error does not exceed 1½ per cent. Comparing these values for P_2 and S_2 with those of N_2 and O_2, it is shown that the simple relations found in the case of the inert gases and the halogens also hold in the case of nitrogen and phosphorus, oxygen and sulphur; and that an atom of phosphorus retards light four times as much as an atom of nitrogen, an atom of sulphur four times as much as an atom of oxygen.

Efforts have also been made to measure the index of fluorine in the gaseous state, but, owing to the experimental difficulties, success has not yet been attained.

It appears then, that, out of fourteen elements the index of refraction of which has been measured in the gaseous state, twelve conform to the rule that in each chemical group the refractivities of the elements are in the ratios of small integers. The other two, Hg and H, have no allied elements with which they can be compared.

It is pointed out that N, O, and Ne are each followed, in their respective families, by an element the refractivity of which is four times as great, and that, consequently, there are reasons for believing that the elements composing the series N, O, F, and Ne, and P, S, Cl, and A are, in some sense, homologous. Comparing the refractivities of the latter series we see that the power to retard light appears to be closely connected with the valency, increasing as it increases, in spite of the decrease in atomic weight, as shown in the following table:—

	Element			
	P	S	Cl	A
Atomic weight ...	31	32	35·5	40
Refractivity ...	299×4	275×4	192×4	141×4

The series Ne, O, N, show the same relation, and it is probable that the refractivity of C is even higher than that of N.

The refractivity of B, estimated from BCl_3 and BBr_3, is certainly very great; but whether it exceeds that of C there is not sufficient evidence to determine.

December 1.—"On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks.—V. On a New Type of Sphenophyllaceous Cone (*Sphenophyllum fertile*) from the Lower Coal-measures." By Dr. D. H. **Scott,** F.R.S.

The class Sphenophyllales, of which the fossil described is a new representative, shows on the one hand clear affinities with the Equisetales, while on the other it approaches the Lycopods; some botanists have endeavoured to trace a relation to the ferns. The nearest allies among recent plants are probably the Psilotaceæ, which some writers have even proposed to include in the Sphenophyllales.

The new strobilus appears to find its natural place in the type-genus Sphenophyllum, as at present constituted, but it possesses peculiar features of considerable importance, which may probably ultimately justify generic separation. The specimen, of which a number of transverse and longitudinal sections have been prepared by Mr. Lomax, is from one of the calcareous nodules of the Lower Coal-measures

of Lancashire, and was found at Shore Littleborough, a locality rich in petrified remains, now being opened up by the enterprise of the owner, Mr. W. H. Sutcliffe.

The close affinity of the strobilus with Sphenophyllum is shown by the anatomy of the axis, which has the solid triarch wood characteristic of that genus, and by the fact that the whorled sporophylls are divided into dorsal and ventral lobes, as in all other known fructifications of this class. But whereas, in all the forms hitherto described, the lower or dorsal lobes are sterile, forming a system of protective bracts, while the ventral lobes alone bear the sporangia; in the new cone, dorsal and ventral lobes are alike fertile, and no sterile bracts are differentiated. On this ground the name *Sphenophyllum fertile* is proposed for the new species.

Each lobe of the sporophyll divided palmately into several segments, the sporangiophores, each of which consisted of a slender pedicel, terminating in a large peltate lamina, on which two pendulous sporangia were borne. In the bi-sporangite character of the sporangiophores, and in other details of structure, *Sphenophyllum fertile* approaches the *Bowmanites Römeri* of Count Solms-Laubach, while in the form and segmentation of the sporophylls there is a considerable resemblance to the Lower Carboniferous genus Cheirostrobus.

The wall of the sporangium has a rather complex structure, the most interesting feature in which is the well defined small-celled stomium, marking the line of longitudinal dehiscence.

The spores, so far as observed, are all of one kind; they are ellipsoidal in form, with longitudinal crests or ridges; their dimensions are 90–96μ in length by 65–70μ in width.

The most characteristic point in the structure of the new cone—the fertility of both dorsal and ventral lobes of the sporophyll—is regarded as more probably due to special modification than to the retention of a primitive condition.

"On the Presence of Tyrosinases in the Skins of some Pigmented Vertebrates.—Preliminary Note." By Florence M. **Durham.**

An extract can be made from the skins of certain pigmented animals (rabbits, rats, guinea-pigs and chickens) which will act upon tyrosin and produce a pigmented substance. This action suggests the presence of a tyrosinase in the skins of these animals.

The action of the tyrosinase is destroyed by boiling, does not take place in the cold, is delayed by time, requires a temperature of about 37° C., and also the presence of an activating substance such as ferrous sulphate to start it.

The coloured substances produced are in accordance with the colour of the animals used. Black substances are obtained, when animals with black pigment in their skins are used, and yellow substance, when the skin contains the orange pigment. The coloured substances are soluble in alkalis, but insoluble in acids.

Anthropological Institute, November 22.—Mr. H. Balfour, president, in the chair.—Dr. Ed. **Westermarck** read a paper on the magic origin of Moorish designs. The designs are largely derived from charms against the evil eye. A Moor protects himself against the evil eye of another person by stretching out the five fingers of his right hand, saying, "five in your eye." The object of this gesture is to throw back the evil power, *l-bas*, which has emanated from the other person's eye. The number five by itself has thus come to be regarded as a charm against the evil look. This was illustrated by a number of lantern slides, showing charms, and designs grown out of charms. Silver amulets containing a double five grouped in the form of a cross, with a piece of blue glass as a common centre, are in frequent use. Magic efficacy is attributed to the cross, not only because it represents a five, but also, as it seems, because it is regarded as a conductor for baneful energy, which is dispersed by it in all the quarters of the wind. The double five is often represented as an eight-petalled rosette, or a double cross, with or without a well marked centre. By joining the extremities of the lines which form each of the two crosses, two intersecting squares are produced; they are probably intended to represent a pair of eyes. By painting over all the lines which fall within the two intersecting squares, or by hollowing the two squares, the artist produces an empty octagon. The two crosses may also be of different lengths, and then the joining of the extremities of each cross gives rise to two squares, of which the one is inscribed in the other. The tendency to produce the number five double as double five, an eight petalled rosette, a double cross, or a double square seems to be due to the fact that the protective gesture is sometimes performed both with the right and left hand. By doubling each petal in the eight-petalled rosette, the sixteen-petalled rosette has been produced. The image of an eye or a pair of eyes is also used to throw back the baneful energy emanating from an evil eye. The eye is sometimes represented as round, sometimes as a triangle (the two intersecting triangles seem to represent a pair of eyes), sometimes with a triangular eyebrow. A row of triangular eyes and eyebrows, or of eyebrows alone, is a common design on carpets.

Geological Society, November 23.—Dr. J. E. Marr, F.R.S., president, in the chair.—On an ossiferous cavern of Pleistocene age at Hoe-Grange Quarry, Longcliffe, near Brassington (Derbyshire): H. H. **Arnold-Bemrose** and E. T. **Newton,** F.R.S. The quarry is situated near the top of the plateau, at about 1100 feet above Ordnance-datum. The cave is evidently a master-joint in the limestone, enlarged by water, and, besides being a swallow-hole, has served as a hyæna-den. The large number of mammalian remains found includes lion, hyæna, rhinoceros, Elephas, and other Pleistocene forms; but, besides these, there were numerous bones and teeth of fallow-deer, mixed with the Pleistocene remains at all horizons in the cave. The physical conditions are such as to preclude, as the authors think, any idea of a re-deposition of the bones at any date subsequent to the Pleistocene period; and it is concluded, therefore, that the fallow-deer (*Cervus dama*) was a Pleistocene species, although hitherto supposed to be a much later introduction.—The superficial deposits and pre-Glacial valleys of the Northumberland and Durham Coalfield: D. **Woolacott.** Six volumes, published by the North-of-England Institute of Mining and Mechanical Engineers, contain a large number of borings made in the northern coalfield. A considerable proportion of these are most valuable in showing the nature and distribution of the superficial deposits. From them and from field-mapping it is possible to form a fairly accurate conception of the pre-Glacial floor of the district and its drainage, and also of the relative changes of level before, during, and after the Glacial period.

Zoological Society, November 29.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Observations on the field natural history of the lion made during seventeen years of travel and residence in Central Africa: Captain Richard **Crawshay.**—Some nudibranchs from East Africa and Zanzibar, part vi.: Sir Charles **Eliot.** The paper contained an account of thirty species and varieties, of which eight of the former and one of the latter were described as new.—Some photographs of giraffes and a zebra taken from pictures in the art collection at Windsor Castle, and an old print of a zebra dated 1762: R. **Lydekker.** Mr. Lydekker was of opinion that the picture and print of the zebra had been taken from the same animal.—Two specimens of lorises, one a slow loris (Nycticebus) and the other a slender loris (Loris), recently acquired by the British Museum: R. **Lydekker.** The latter specimen was pointed out to be sufficiently different from the typical *L. gracilis* to be entitled to subspecific rank.—The morphology and classification of the Asellota group of crustaceans, with descriptions of the genus Stenetrium and its species: Dr. H. J. **Hansen.**—The lizard *Lacerta depressa* of Camerano and its varieties: G. A. **Boulenger,** F.R.S.—A small collection of fresh-water Entomostraca from South Africa: R. **Gurney.** The collection comprised examples of five species, three of which were described as new.—The cranial osteology of the Egyptian mastigure (*Uromastix spinipes*): F. E. **Beddard,** F.R.S.

Chemical Society, December 1.—Prof. W. A. Tilden, F.R.S., in the chair.—The nitrites of the alkali and alkaline earth metals and their decomposition by heat: P. C. **Rây.** These nitrites are shown to be comparatively stable, and their aqueous solutions can be evaporated to dryness without decomposition or oxidation taking place. When barium nitrite is heated it is first converted into barium oxide and

barium nitrate, the latter finally also being decomposed into baryta.—Metallic derivatives of nitrogen iodide and their bearing on its constitution: O. **Silberrad.** Guyard's supposed copper derivative of nitrogen iodide is shown to be a cuprosamine periodide. The silver derivative described by Szuhay is found to be a true nitrogen iodide derivative of the formula NI_3,NH_2Ag.—Synthesis of 1 : 1-dimethylhexahydrobenzene: A. W. **Crossley** and Nora **Renouf.**—The formation and reactions of iminocompounds, (i.) condensation of ethyl cyanoacetate with its sodium derivative: H. **Baron,** F. G. P. **Remfry,** and J. F. **Thorpe.** This is a preliminary communication regarding the properties of compounds containing the group —C(=NH)—, which in some respects closely resembles the =CO group in reaction.—The affinity constants of aniline and its derivatives: R. C. **Farmer** and F. J. **Warth.** These constants are best measured in such cases by determining the distribution of the salts between two immiscible solvents applied simultaneously. The following substituents exert a decreasing electronegative action, in the order in which they are given, on the affinity constant of aniline:—NO_2,COOH,—N=NPh,Br,Cl,Me,OMe. — The attractive force of crystals for like molecules in saturated solutions: E. **Sonstadt.** Crystals of a salt were placed in saturated solutions of the same salt, and the amount of the latter withdrawn from the solution by the attractive force of the crystals was determined periodically.—The Grignard reaction applied to the esters of hydroxy-acids: P. F. **Frankland** and D. F. **Twiss.** A substance which is probably αaδδ-tetraphenylerythritol was obtained by the action of magnesium phenyl bromide on dimethyltartrate.—Note on the addition of hydrogen cyanide to unsaturated compounds: A. **Lapworth.** It is shown that in spite of Knoevenagel's assertion to the contrary, there is no experimental evidence that mesityl oxide unites directly with hydrogen cyanide except in the presence of alkalis. The author is now engaged in the examination of a number of products obtained by the interaction of aldehydes with chloroacetates in presence of potassium cyanide.

Mathematical Society, December 8.—Prof. Forsyth, president, in the chair.—The following papers were communicated:—On a deficient multinomial expansion: Major **MacMahon.** A generalisation of the binomial theorem, made by Abel and restated by Cayley, leads to the consideration of the series that is obtained from an ordinary multinomial expansion by restricting the indices of the terms to obey certain Diophantine inequalities. The paper contains investigations of the number of terms in such a series, the sum of the coefficients, and a syzygetic theory of the distinct terms.—The application of basic numbers to Bessel's and Legendre's functions: Rev. F. H. **Jackson.** The author generalises various functions that are expressed by power series by replacing n in the coefficient of x^n by $(p^n-1)/(p-1)$. Two generalisations are obtained of Bessel's functions, one being derived from the other by inversion of the "base" p. In the present paper the author shows that these two functions are connected by a relation containing basic exponential functions. He obtains also generalisations of a number of results which bear on the relations between Legendre's functions and Bessel's functions, and he connects the theory of the generalised Legendre's functions with that of the Theta functions.—On groups of order $p^\alpha q^\beta$: Prof. W. **Burnside.** In a previous paper the author had proved that these groups are soluble. In the present paper it is shown that, subject to certain specified exceptions when the order is even, a group of the specified order in which $p^\alpha > q^\beta$ must have a characteristic subgroup of order p^a, where a is such that p^a is greater than $p^\alpha q^{-\beta}$.—On the failure of convergence of Fourier's series: Dr. E. W. **Hobson.** Fourier's series formed for a continuous function may not converge at a point, and then it does not represent the function at the point. In the paper attention is directed to a class of series which fail to converge, but can be made to converge to any assigned value by enclosing suitable sets of terms in brackets and treating the terms in a bracket as a single term. No example has ever been found of a non-convergent Fourier's series which cannot be included in this class. The nature of the set of points in the periodic interval at which a Fourier's series fails to converge is discussed, and it is shown that, when the function to be represented by the series is continuous, this set has the "measure" zero.—An extension of Borel's exponential method of summation of divergent series applied to linear differential equations: E. **Cunningham.** The object of the paper is to make more precise the connection between Laplace's solution of linear differential equations in terms of definite integrals and the asymptotic expansion of the solution as the product of an exponential function and a descending power series. The latter series, with the exponential factor omitted, is shown to be "summable" in a sense analogous to that of Borel's theory; and it is proved that the fundamental properties of summable divergent series, such as differentiation term by term, addition and multiplication term by term, are valid for the series in question.—On the linear differential equation of the second order: Prof. A. C. **Dixon.**

CAMBRIDGE.

Philosophical Society, November 14.—Prof. Marshall Ward, president, in the chair.—The charge of the α rays from polonium: Prof. **Thomson,** F.R.S. A bismuth disc covered with polonium (or radio-tellurium), as supplied by Sthamer, was mounted on pivots in a vacuum tube. In front of the disc and about 3 cm. from it was a very carefully insulated gold-leaf electroscope which could be charged with either positive or negative electricity. The vacuum tube was exhausted by first pumping out as much air as possible by a mercury pump, and then using Dewar's method of extracting the remainder of the air by dense charcoal cooled by liquid air. In this way vacua were obtained very much superior to those got by pumping alone. It was found that at these very low vacua the electroscope in front of the polonium if negatively charged leaks so slowly that it is hardly possible to measure the leak with accuracy; while if the electroscope is positively charged its leak is very rapid, certainly more than 100 times the leak when charged negatively. Thus the polonium gives out large quantities of negative electricity, but not enough positive to be detected; this is very remarkable, as polonium is generally supposed to give out nothing but α rays. In order to see that the positive electricity had not been swamped by the negative the instrument was placed in a strong magnetic field; this stopped the negative corpuscles coming out of the polonium from reaching the electroscope, and it was found that now the latter no longer leaked when charged with positive electricity; but though the negative particles had been stopped no positive ones could be detected, for there was no leak from the electroscope when negatively electrified. The author was never able to be sure of any *increase* in the charge of a negatively electrified body placed near the polonium; this he thinks is due to the negative particles from the polonium moving so slowly that they are unable to make headway against the repulsion exerted by a negatively electrified body. The α rays of polonium are deflected by a magnet, hence they must be positively charged at some part, at any rate, of their course, yet no trace can be found of this charge when the rays strike against an electroscope. The question is discussed whether the α particles lose their charge when they pass through the cloud of negative ones near the polonium, or whether they are alternately charged and discharged, the time during which they are uncharged being much longer than the time they are charged.—On the dynamical significance of Kundt's law of selective dispersion in connection with the transmission of the energy of trains of dispersive waves: Prof. **Larmor,** F.R.S.—The chlorination of α picoline: W. J. **Sell,** F.R.S.—An attempted synthesis of uric acid: H. J. H. **Fenton,** F.R.S.—The diffusion of hydrogen through palladium: O. W. **Richardson.** The paper is chiefly a criticism of the conclusions drawn by Mr. G. N. St. Schmidt (*Drude's Ann.*, vol. xiii. p. 747) from his experiments on this subject. The author shows that the known facts can be explained on the hypothesis that the hydrogen inside the metal is dissociated, in the same way as for platinum.—Optically active nitrogen compounds: Miss M. B. **Thomas** and H. O. **Jones.** The work was undertaken in order to find out what connection exists between the constitution of optically active nitrogen compounds and the numerical value of their rotatory power. The rotation for a basic ion may be determined by preparing the salt with an acid of known rotatory power, and subtracting the rotation due

to the acidic ion from the total rotation of the salt in aqueous solution. The series of substituted ammonium salts under investigation contain the phenyl, benzyl, and methyl radicals with ethyl, *iso*propyl, *iso*butyl or *iso*amyl. The paper contains a brief account of the resolution of the *iso*propyl compound by means of its dextro-brom-camphor-sulphonate.

DUBLIN.

Royal Dublin Society, November 15.—Dr. R. F. Scharff in the chair.—Prof. T. **Johnson** gave an account of a disease of swedes which has caused considerable loss in different parts of Ireland, especially in the west. The small leaves become "spotted," turn yellow, and fall off. The attack is due to *Cercospora Bloxami*, Berk. and Br., which causes disease in swedes in Germany and Switzerland. Associated with the Cercospora from different localities, the author found a Phoma-stage, suggestive of *Phoma Brassicae*, Thüm., and in one locality, associated also with Cercospora, *Pleospora herbarum*, β *Brassicae* (Lasch), Sacc. The swede disease shows a curious parallelism with the disease of the sweet chestnut investigated by Berlese in Italy, where Cercosporella, Phoma or Phyllosticta, and Sphærella stages are associated.—Prof. W. F. **Barrett,** F.R.S., read a paper on a method of protecting the hands of the operator from X-ray burns. The author stated that in taking some radiographs of surgical cases during the first three months of 1896 (shortly after Röntgen's discovery) he noticed the extreme opacity to the X-rays of any bandages which contained a dressing of iodoform. This led to a series of experiments on the relative transparency of bodies to the X-rays, and it was discovered, early in March, 1896, that all bodies of high molecular weight, such as iodoform, were opaque to these rays. If, then, the burns produced by the X-rays be due to those rays which cannot penetrate a layer of iodoform, it is easy to construct gauntlets with an inner lining filled with iodoform which would entirely protect the hands of the operator. Such gloves would be far more flexible and far lighter than gloves with a lead lining. The author added to his paper an historical note on the relative transparency of bodies to the X-rays, giving a brief summary of the work done.

MANCHESTER.

Literary and Philosophical Society, November 15.—Prof. W. Boyd Dawkins, F.R.S., president, in the chair.—Dr. W. E. **Hoyle** exhibited specimens of certain rare Cephalopoda:—(1) *Ancistrochirus lichtensteini* from the Maldive Archipelago, the type specimen in the Paris Museums being the only one previously known. (2) A species of Cirroteuthis from the neighbourhood of the Cape of Good Hope, beautifully preserved in formol, and exhibiting the gelatinous appearance and rounded stumpy form of the animal in a way never seen in examples preserved in alcohol. (3) Section of an octopod embryo from Zanzibar showing a number of peculiar chitinous rods in the epithelium.—Mr. F. **Nicholson** communicated a note on the mistaken idea that birds are seed-carriers, in which the author stated that he had found no evidence from his own observations, extending over many years, that entire seed can pass through a healthy bird. In confirmation of this view Mr. Nicholson quoted two passages from Macgillivray's "A History of British Birds," in which the author states that of many hundreds of berry-eating and seed-eating birds which he had opened there were only two which showed the presence of whole seed in their intestines, and these two were in all probability cases of diseased action.—Mr. R. W. **Ellison** exhibited a number of birds' eggs, including specimens of the following:—the great black-backed, the lesser black-backed, the herring, and black-headed gulls, the Sandwich and lesser terns, the ring sand plover, and the guillemot. The selection was made with the view of demonstrating certain facts as to the coloration of the eggs and its relation to that of their surroundings.

PARIS.

Academy of Sciences, December 5.—M. Mascart in the chair.—On the general formula giving the number of double integrals of the second species in the theory of algebraic surfaces: Émile **Picard.**—On the nepheline rocks of Tahiti: M. **Lacroix.** A detailed examination of a series of rocks from Tahiti constitutes a continuous series from a petrographical point of view, in which the mineralogical variations are essentially the result of an increase in the amount of lime, iron, and manganese, accompanied with a corresponding reduction in the amount of silica and alkalis.—On differential equations of a parabolic type: Vito **Volterra.**—Observations on the Perseids for 1904, and the determination of their heights above the ground: V. **Fournier,** A. **Chaudot,** and G. **Fournier.** The observations were carried out on the nights between August 9 and 16. 274 meteors were registered, 180 of which were Perseids. Only 27 of these were of the first magnitude, the greater part being of the third or fourth order. With the view of determining the heights of some of the meteors simultaneous observations were carried out on the night of August 16 at Rouvray and at Morvan (Côte d'Or), two stations 10·1 kilometres apart. 32 shooting stars were noted at the first station, and 52 at the second, 13 of these being common to both, and of these 4 have been reduced. The height at the first appearance varied from 107 to 283 kilometres, at disappearance from 35 to 66 kilometres, and the length of the trajectory from 56 to 245 kilometres. The average height for the first appearance was 168 kilometres, and of disappearance 53 kilometres, these figures being greater than those obtained by M. Chrétien in 1901.—On groups of the order $p^m(p$ prime, $m>4)$ of which all the divisors of the order p^{m-2} are Abelian: M. **Potron.**—The design of high-speed vessels: Vice-Admiral **Fournier.**—On telestereoscopy: Paul **Helbronner.** The object of the experiments was, whilst preserving the strong magnification of the telescope objective, to get the details standing out in clear relief. The arrangement described has been used in geodesic work in the French Alps, and has been found very useful.—Researches on dielectric solids: V. **Crémieu** and L. **Malclès.** By means of a quantitative study of the phenomena described qualitatively in a previous note, the diminution of electrical influence through solid dielectrics by the production in the dielectric of a reactive charge is clearly established.—Experiments permitting of the demonstration of the *n*-rays: H. **Bordier.** With the view of removing objections to the purely subjective experiments which are used for the detection of the *n*-rays, the author has applied with success a photographic method, very long exposures being employed on account of the feeble intensity of the light emitted.—On the composition of colloidal granules: Victor **Henri** and André **Mayer.** The composition of the colloidal granules of copper ferrocyanide studied by J. Duclaux may be considered as a particular case of the phenomenon of adsorption. The granules may be looked upon as formed by copper ferrocyanide which has adsorbed a certain quantity of potassium ferrocyanide. It is not necessary that compounds of indefinite chemical composition should be assumed.—The action of methylene chloride upon toluene in the presence of aluminium chloride: James **Lavaux.** It is shown that the ditolylmethane and dimethylanthracene isolated by previous workers on this reaction are mixtures. From the former the author has isolated dimeta- and dipara-ditolylmethane, and β-methylanthracene, and from the latter three isomeric dimethylanthracenes.—On the retrogradation of some cyclic secondary amines: P. **Lemoult.** Amines of the type R—NHR′ on heating with PCl_5 give some of the primary amine RNH_2, together with R′Cl. The reaction was best marked with the methylanilines.—On the organic combinations of metals in plants: MM. **Schlagdenhauffen** and **Reeb.**—On the synthesis and chemical nature of sorbierite: Gabriel **Bertrand.** It is shown synthetically that the sorbierite described by the author in a previous paper is identical with the *d*-idite of Fischer and Fay.—The biological *rôle* of the diffusion of liquids: Stéphane **Leduc.**—Researches on the germination of the spores of some yeasts: A. **Guilliermond.**—On the anatomical modifications which are produced in the course of the evolution of certain rhizomes: André **Dauphiné.**—Biospeleology: Armand **Viré.** A discussion of the bearing of the evidence of the animals found in caves on the theory of evolution.—Osmotic communication between the vital and exterior media in certain marine Selacian fishes: René **Quinton.**—*Lernaeenicus Sprattae*, a parasite of the sardine on the coasts of Vendée: Marcel **Baudouin.**—The action of calcium permanganate on alkaloids, and in particular on strychnine: G. **Baudran.**—The nutritive value of cows' milk, sterilised at 108° C., for artificial feeding: G. **Variot.** As the result of work carried on over a period of

twelve years, on an average of 150 to 200 infants daily, the conclusions are drawn that milk sterilised at 108° C. preserves all its nutritive value, and is in no way inferior to milk pasteurised at 80° C. or simply heated to 100° C. No appreciable decrease in the readiness with which the milk was assimilated could be noticed, and not a single case of infantile scurvy occurred. The percentage of infants incapable of utilising sterilised milk was between 3 per cent. and 4 per cent.

NEW SOUTH WALES.

Royal Society, October 5.—Mr. C. O. Burge, president, in the chair.—Ethnological notes on the aboriginal tribes of New South Wales and Victoria: R. H. **Mathews.**—Preliminary observations on radio-activity and the occurrence of radium in Australian minerals: D. **Mawson** and T. H. **Laby.** A brief summary of observations on the radio-activity of minerals and occurrence of radium is given, showing that comparatively intense activity is only found associated in minerals with thorium and uranium. A torbernite and euxenite were found highly active, but the specimens were too small to examine for radium. A Western Australian gadolinite, found by Prof. Norman Collie to contain one bubble of helium in ten grams, was expected to contain radium, but none could be detected. Twelve monazites were found radio-active; one, with double the average activity of the others, from Pilbarra, Western Australia, gave on heating the radium emanation; five monazite and zircon sands were also active. No relation between thoria contents and activity was found, which points to the presence of uranium.—The flood deposits of the Hunter and Hawkesbury Rivers: Prof. F. B. **Guthrie** and Prof. T. W. Edgeworth **David.**

CAPE TOWN.

South African Philosophical Society, September 28.—Dr. J. D. F. Gilchrist, president, in the chair.—A new South African cypress, *Callitris schwarzii*, Marl.: Dr. R. **Marloth.** The two species of cypress hitherto known from South Africa belong to the genus Widdringtonia, which, however, is now mostly merged into the genus Callitris. Until recently only one other species of Widdringtonia was known, viz. *W. Commersoni* from Madagascar, but lately a fourth species has been found by Whyte on the Shire Highlands, called by Sir H. H. Johnston the Malanje cedar. The South African species are *C. juniperoides*, the so-called Cape cedar, and *C. cupressoides*, the sapreehout. The former is a tree from 30 to 40 feet high, and occurs only on the Cedar Mountains, while the latter is only 10 to 12 feet or rarely 15 feet high, but is common on all the mountains of the south-western districts. When recently the author heard that some "Sapree" trees in the Baviaanskloof Mountains were 50 to 60 feet high, he suspected at once that this must be a different species, and an examination of some ripe cones proved that this tree is quite distinct from the common *C. cupressoides*.—The Glacial conglomerate in the Table Mountain series near Clanwilliam: A. W. **Rogers.** This communication is an extension of one read before the society in 1901. The conglomerate with glaciated pebbles has now been traced through a distance of about 23 miles near Clanwilliam.—South African Verbenaceæ, supplementary note: H. H. W. **Pearson.**—Further note on factorisable continuants: Thos. **Muir.**—South African Hymenoptera: P. **Cameron.**—On the structure of the endothiodont reptiles: R. **Broom.**

October 26.—Sir David Gill, K.C.B., F.R.S., vice-president, in the chair.—The rocks of Tristan d'Acunha, brought back by H.M.S. *Odin*, Commander Pearce, R.N., and their bearing on the question of the permanence of ocean basins: E. H. L. **Schwarz.** Through the courtesy of Commander Pearce, of H.M.S. *Odin*, a number of specimens were recently obtained for the South African Museum from the island group of Tristan d'Acunha. The islands are described in the *Challenger* reports, and from the accounts published in them it is evident that while Inaccessible Island and Tristan d'Acunha itself are ordinary volcanic islands, Nightingale Island is a gigantic agglomerate neck like those that the author has described from Griqualand East, on the flanks of the Drakensberg Mountains. Two rocks of a type unusual to volcanic islands were brought back by the expedition; one was a white mica and biotite gneiss from Tristan d'Acunha, the other a lava containing foreign fragments from Nightingale Island.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 15.

ROYAL SOCIETY, at 4.30.—On the Ultra-violet Spectrum of Gadolinium: Sir William Crookes, F.R.S.—An Analysis of the Results from the Falmouth Magnetographs on "Quiet" Days during the Twelve Years 1891 to 1902: Dr. C. Chree, F.R.S.—The Halogen Hydrides as Conducting Solvents. Part iii. Preliminary Note: B. D. Steele.—The Halogen Hydrides as Conducting Solvents. Part iv. Preliminary Note: B. D. Steele, D. McIntosh, and E. H. Archibald.—Effects of Temperature and Pressure on the Thermal Conductivities of Solids. Part i. The Effect of Temperature on the Thermal Conductivities of some Electrical Insulators: Dr. C. H. Lees.—The Basic Gamma Function and the Elliptic Functions: Rev. F. H. Jackson, R.N.—On the Normal Series satisfying Linear Differential Equations: E. Cunningham.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on Mr. Searle's Paper, Studies in Magnetic Testing; Followed by The Combination of Dust Destructors and Electricity Works, Economically Considered: W. P. Adams.

LINNEAN SOCIETY, at 8.—The Ecology of Woodland Plants: Dr. T. W. Woodhead.—Experimental Studies on Heredity in Rabbits: C. C. Hurst.

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Heat Treatment Experiments with Chrome-Vanadium Steel: Capt. H. Riall Sankey and J. Kent-Smith.—Messrs. Seaton and Jude's Paper on Impact Tests on the Wrought Steels of Commerce will be discussed.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Folkestone Harbour: Cylinder-Sinking at the Root of the Old Pier: R. H. Lee Pennell.

MONDAY, DECEMBER 19.

SOCIETY OF ARTS, at 8.—Musical Wind Instruments, Flutes: D. J. Blaikley.

INSTITUTE OF ACTUARIES, at 5.—On the Retrospective Method of Valuation: Frederick Bell.

FARADAY SOCIETY, at 8.—The Electric Furnace; its Origin, Transformation, and Applications. Part ii.: A. Minet.—Electrolytic Analysis of Cobalt and Nickel: F. Mollwo Perkin and W. C. Prebble.—(1) The Electrolytic Preparation of Tin Paste. (2) Note on the Electrolytic Recovery of Tin: F. Gelstharp.

TUESDAY, DECEMBER 20.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion* on the Construction of a Concrete Railway-Viaduct: A. Wood-Hill and E. D. Pain.

WEDNESDAY, DECEMBER 21.

GEOLOGICAL SOCIETY, at 8.—Certain Genera and Species of Lytoceratidæ: S. S. Buckman.—(1) The Leicester Earthquakes of August 4, 1893, and June 21, 1904. (2) The Derby Earthquakes of July 3, 1904. (3) Twin-Earthquakes: Dr. C. Davison.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Theory of Highly Magnified Images: J. W. Gordon.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Discussion of Mr. F. J. Brodie's paper, Decrease of Fog in London during Recent Years. Followed by The Study of the Minor Fluctuations of Atmospheric Pressure: Dr. W. N. Shaw, F.R.S., and W. H. Dines.

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